Vault

DENTISTRY LIBRARY

THE DENTAL PRACTITIONER and DENTAL RECORD

VOL. XII, NO. 1 SEPTEMBER, 1961

Including the Transactions of the British Society for the Study of Orthodontics and the official reports of the British Society of Periodontology, the Glasgow Odontological Society, the Liverpool and District Odontological Society, the North Staffordshire Society of Dental Surgeons, the Odonto-chirurgical Society of Scotland, and the Dental and Medical Society for the Study of Hypnosis

CONTENTS

PAGE

EDITORIAL: FLUORIDATION - - - - - - - - - - - 1

ENAMEL DEFECTS IN A CASE OF TURNER'S SYNDROME - *Joan Weyman*, B.D.S., F.D.S., D.Orth. R.C.S. 3

PERFORATION OF A MANDIBULAR THIRD ROOT MOLAR DIAGNOSED PRE-OPERATIVELY
J. R. Pettman, L.D.S. (Dunelm.), D.Orth. R.C.S. 8

THE PERIODONTAL POCKET STUDIED BY THREE-DIMENSIONAL RADIOGRAPHY
Nils Berghagen and Kurt Blom 10

BOOK REVIEWS - - - - - - - - - - - - 21

ABSTRACTS FROM OTHER JOURNALS - - - - - - - - 2, 20, 23

TRANSACTIONS OF THE BRITISH SOCIETY FOR THE STUDY OF ORTHODONTICS:
EXTRA-ORAL TRACTION IN ORTHODONTICS - *S. Granger McCallin*, L.D.S., D.Orth. R.C.S. 25

JOHN WRIGHT & SONS LTD., BATH ROAD, BRISTOL 4

THREE SHILLINGS AND SIXPENCE

What's so special about

New ACRYLUCENT?

Why are they preferred by so many? Why do those who have tried them once, use them always? And why are so many changing over to New ACRYLUCENT?

There's no mystery about it . . . .* New ACRYLUCENT *are teeth as teeth ought to be . . . . probably the finest in the world.

Mould Charts and Shade Guides supplied on request

COTTRELL & COMPANY

15-17 · CHARLOTTE STREET · LONDON W.1

and at: 56 · GEORGE STREET · EDINBURGH 2

THE DENTAL PRACTITIONER AND DENTAL RECORD

Vol. XII, No. 1 September, 1961

EDITORIAL

FLUORIDATION

MEMBERS of the public at large are usually surprised when told by their dentists that one of the major aims of the profession is the *prevention* of dental disease. There are few professions whose ultimate aim is to eliminate to some measure their object for existing, and few people find it easy to believe that such an ideal exists.

Despite this expression of our public aim—how much do we actually do as individual dentists to promote it? In the view of THE DENTAL PRACTITIONER still too little to ensure marked results. This is particularly so in the case of fluoridation.

For half a century now we have known that the addition of fluorine to the constituents of tooth structure plays an important part in making the teeth impervious to the destructive elements of dental decay. In recent years various methods have been devised for introducing this material into the tooth. None of these methods guarantees complete protection, but they do provide a means of reducing the ravages of caries.

The simplest procedure is that of adding the chemical to the water-supplies, but this has met with opposition for a variety of reasons and only a few communities therefore receive its benefits. More recently fluorine tablets have become available which may be taken orally to increase the fluoride content of the tooth.

Another simple method—but time-consuming, and therefore unpopular with many dentists—is a topical application of sodium or stannous fluoride to the individual teeth. This application, also, unfortunately lacks the demonstration of immediate results, and the payment for this service by either patients or the National Health Service is relatively unremunerative to the practitioner. Continued statements from official sources that the Ministry of Health are extremely interested in preventative dentistry would appear to belie the facts. Could it not be treated in the same way as the anti-polio campaign? Supplies of stannous fluoride should be made available through the public health authorities to every dentist (particularly in the School Dental Service) for the treatment of the young people of this country. Also an inducive remuneration should be given to practitioners for each treatment.

In the meantime, the toothpaste and chewing-gum manufacturers have gone ahead with experimental work on the inclusion of fluorine in their products. Although the profession in this country has been guarded in considering the true value of this method, nevertheless it has to some degree received the approval of the American Dental Association.

DENTAL LIBRARY
RK
1
D417
P83

However, it is—in the final analysis—the efforts of the individual dentist to promote one or other of these fluoridation methods which will help to end the scourge of dental disease.

Since the inception of this Journal it has been the policy of the Editors to have a monthly Editorial. As, however, THE DENTAL PRACTITIONER does not concern itself with dental politics—the chief source of material on which to base Editorials—it is now felt that these Editorials would serve a more useful purpose if they appeared less often and only when the need arose to comment on some topic of immediate importance. Therefore, with this issue of THE DENTAL PRACTITIONER, the inclusion of an Editorial in every issue will cease.

THE NATURAL BARRIERS TO INFECTION IN THE MOUTH

The natural defences of the mouth and the almost constant impermeability of its mucous membrane are very important to the dentist.

Mouth Organisms.—Catarrhal inflammation which is rarely absent from some part of the mouth favours the lodgement of bacteria, and suitable nutrition for them is found on sloughing epithelium and decayed teeth and food particles. Great numbers of a large variety of organisms are always present, others commonly so, and yet others sporadically.

The Natural Barriers.—Despite this large flora, injury to the oral and pharyngeal mucous membrane seldom leads to serious infection or delayed healing. Apparently, under ordinary conditions the presence of surface organisms is associated with the development of a resistance to them, and in consequence may be regarded as beneficial to the host. Also, the presence of indigenous flora may be a factor in preventing the establishment of non-indigenous forms. Although prominence has been given to a mechanical effect of the saliva in oral bacterial control, it has also been postulated that anti-bacterial factors present in saliva are of major significance in regulating oral resistance to infection. From a list of a dozen enzymes present in saliva only lysozyme has been shown to possess bactericidal activity, and this by hydrolysis of a constituent of the bacterial membranes.

The mouth is lined by a thick, strong layer of stratified squamous epithelium. There is evidence that this mucous membrane not only repels non-indigenous micro-organisms but also limits the proliferation of, and prevents invasion by, the normal flora. The mechanism of the process is not understood, but it is probably connected with the enzymes, the limiting action of some bacteria on others, and with a complex group of factors which determines the integrity of tissues and cells. From all parts of the mouth saliva is directed backwards to the pharynx, and the rate of flow is such that foreign matter is in this way disposed of in less than half an hour.

The integrity of the epithelium is most often broken along the gingival margin and in the depths of the tonsils. The incidence of bacteræmia after exodontia is 38 per cent, after gingivectomy 24 per cent, and after prophylaxis 9 per cent, and the most usual organisms found are *Staphylococcus aureus* and *Streptococcus viridans*. It appears that the disturbance of these organisms by manipulation or surgery rather than the break in the epithelium may be one of the more important causes of bacteræmia that often follow oral therapy. The ducts of the large compound salivary glands, especially that of the parotid, also form vulnerable regions in the lining of the mouth. Cessation of irrigation of these ducts in pathological states deprives the gland of its main defence and accounts for ascending infection of the parotid gland.—WEINBERG, S. (1961), *J. Canad. dent. Ass.*, **27**, 213.

G. E. B. MOORE

BACK NUMBERS

The Publishers would be glad to purchase copies in good condition of Nos. 1 and 5, Vol. I, Nos. 3 and 5, Vol. V, No. 12, Vol. VII, and No. 2, Vol. IX.

ENAMEL DEFECTS IN A CASE OF TURNER'S SYNDROME

By **JOAN WEYMAN**, B.D.S., F.D.S., D.Orth. R.C.S.
Department of Children's Dentistry, Sutherland Dental School, Newcastle upon Tyne

INTRODUCTION

DEFECTIVE enamel may be of three main types: amelogenesis imperfecta, which is generalized; chronologic or periodic, in which the enamel is affected in certain formative periods; and local, due to purely local causes.

Amelogenesis imperfecta combines, under one title, defects occurring at the matrix formation stage and at the maturation stage. The former produces enamel of poor form or quantity but usually well calcified, while the latter results in normal form but poor quality, wearing rapidly and frequently soft to instrumentation by hand. Inevitably there are cases which do not fall naturally into one or other category but have some of the characteristics of both. Although isolated cases are not uncommon, there is often an inherited tendency for both types, being Mendelian dominant in character.

Chronologic or periodic hypoplasia is accepted as being caused by febrile conditions and systemic disturbances of various kinds which upset the normal rhythm of amelogenesis, resulting in hypoplasia rather than hypocalcification, and occurring in bands in the enamel corresponding to the period at which the illness occurred. "Chronologic" is an unsatisfactory term as it does not adequately describe the condition, and "periodic" is felt to be rather better. There is usually no difficulty in diagnosing this condition clinically as the picture is a clear and typical one.

Local hypoplasia occurs on individual teeth and not on teeth in a group, as in periodic hypoplasia. It appears in a variety of forms, such as dull discoloured patches suggesting hypocalcification, a line of pits or a groove round the tooth, or in severe cases of malformation of the whole or part of the crown and frequently combined with hypocalcification. The cause is a local one, usually a septic predecessor when it affects a premolar, or sometimes trauma when a maxillary incisor shows the defect. This lesion is only produced when the cause is operative during the developmental period of the enamel of the tooth affected.

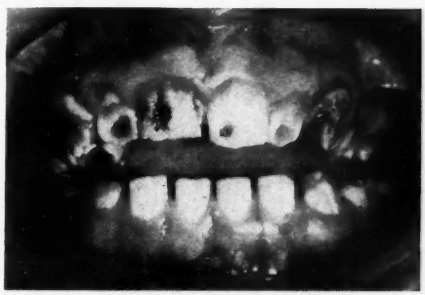


Fig. 1.—Clinical appearance of the anterior teeth of this patient.

It was felt that the following case, which was first believed to be a slightly atypical case of generalized hypocalcification, but which on further investigation was classified as a combination of the first two types of enamel defect already described, namely generalized hypocalcification and periodic hypoplasia, was of interest: it is reported here. The patient described was later diagnosed as having Turner's syndrome or ovarian short-stature syndrome, which is genetic in origin, being associated with the apparent non-inheritance of a sex chromosome from the father, so that the individual possesses only an X chromosome from the mother. Such a patient is primarily female, but develops no ovaries nor secondary sex characters. There is short stature, and coarction of the aorta may be associated with it.

CASE REPORT

This girl (B. W.) requested dental treatment at 12 years 2 months, particularly for her maxillary incisors which were unsightly. She has attended periodically since then and is now 16 years 5 months.

MEDICAL HISTORY.—She was an 8-month baby and vomited frequently during the period of the eruption of her deciduous teeth which, according to the mother, were discoloured. She was diagnosed as having a congenital heart defect, aortic stenosis, which was severe to the extent that climbing stairs caused distress. In appearance she was obese, and short for her age, being 4 ft. 3 in. tall and weighing 100 lb. at 12 years 2 months (normal is 4 ft. 8 in.–5 ft. and 71–91 lb. at 12 years).

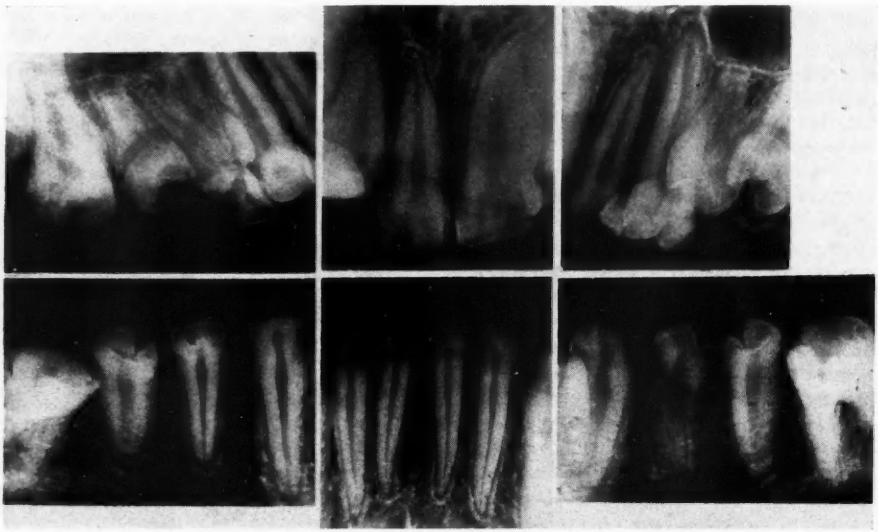


Fig. 2.—Radiographs of the reported case, showing the advanced root development for a child of 10 yr. 2 mth., and the relative radiolucency of the enamel.

Intelligence appeared to be reasonably normal. At the age of 15 years it was advised that she should have surgical treatment to improve the heart condition, and in preparation for this she had great difficulty in reducing her weight to reasonable proportions and very rapidly regained it afterwards. Because of this and because of the delay in development of the secondary sex characters, she was referred to an endocrinologist, who diagnosed Turner's syndrome or ovarian short-stature syndrome.

DENTAL CONDITION.—Records at the age of 8 years 9 months noted that the teeth present were $\frac{6edc21|12cde6}{6edc21|12cde6}$ and that they were hypoplastic, but no special note was made as to the condition of the deciduous teeth. There is a record of $\underline{c\ c}$ being shed later than the eruption of $\underline{3|3}$, causing their temporary displacement.

When examined at the age of 12 years 2 months, all the permanent teeth were erupted except the third molars and previous radiographs confirmed the presence of $\frac{8|}{8|8}$. All the teeth were rather dull in appearance, but quite hard to a probe. In colour $\overline{21|12}$ were yellowish-white and displayed slight grooves across the labial surface in the incisal one-third, and on $\overline{2|2}$ a little nearer the incisal edge than on $\overline{1|1}$. $\underline{21|12}$ were flat or slightly concave labially, with accentuation of the normal vertical contour grooves and of the incremental lines. $\underline{|2}$ had an area of sparse enamel on the labial surface, and $\underline{2|}$ may have been similarly affected, but the area was obscured by caries (*Fig.* 1). The colour was near normal in the incisal half and deeper than normal in the cervical region of these teeth. The cheek teeth were darker than usual, being yellowish-brown, and $\frac{4|\ 45}{|3}$ had defects of the tips which suggested hypoplasia. Attrition was a feature of the mandibular cheek teeth, and this was seen to be more general and severe on $\overline{76|}$ when the girl was examined at 16 years of age. All the teeth were rather small though well within normal limits, with slight spacing present, and there was a marked tendency to the deposition of calculus. Caries was present in $\frac{6\quad 21|1\ 34\ 6}{|\quad\quad 6}$ with associated staining of the dentine. There was Angle's Class II, division 1 malocclusion and a post-normal base relationship. A cross-bite was present on both sides owing to a rather narrow maxillary arch and a normally developed mandibular arch. A slight anterior open bite was also present, but none of these orthodontic features was at all marked. Intra-oral radiographs taken at 10 years 2 months showed that root development was well in advance of the patient's actual age (*Fig.* 2). The maxillary premolars had almost completed apices, while those of $\frac{321|123}{54321|12345}$ were completed. Otherwise the pulps and roots were normal. The enamel showed much less distinctly than usual on all the crowns, and its degree of calcification was judged to be less than normal.

FAMILY HISTORY.—There is no evidence of any dental lesion of this type on the mother's side of the family, but there is a possible case on the father's side (*Fig.* 3). Of a family of 5 siblings, one, a girl, had teeth which "turned

brown at 8–9 years". Her sister stated that only her front teeth were affected, but that they were never convinced that it was due to the iron medicine which the doctor blamed. She died at 20 years of age from a kidney lesion. There are 3 boys in the next generation apart from the immediate family of the patient, and the youngest is now 12 years old: none of them has a similar lesion. The mother stated that the patient "takes after her father except that he is tall".

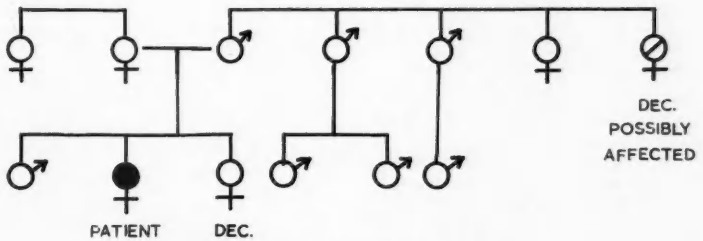


Fig. 3.—Family of the patient described.

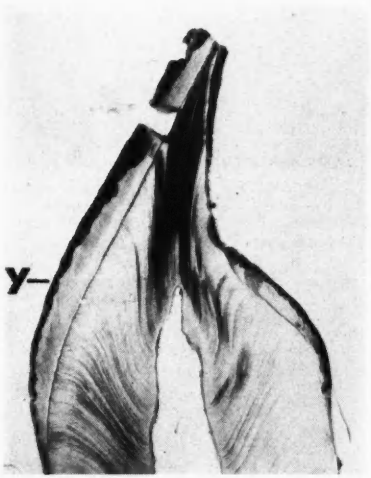


Fig. 4.—Ground section of the central incisor showing areas of hypoplasia on the lingual surface, and the distribution of pigmentation in the enamel. Area "Y"—*see Fig.* 8. (× 5·5.)

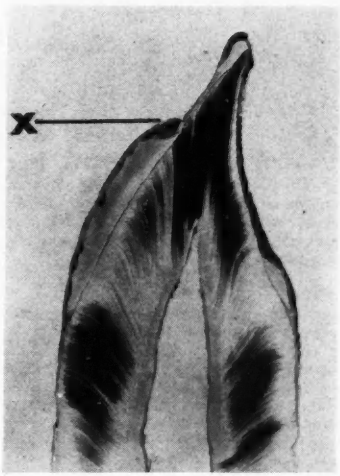


Fig. 5.—Ground section of the lateral incisor showing the distribution of the hypoplasia. The non-pigmented zone at the surface on the lahial side is clearly shown. Area "X"—*see Fig.* 7. (× 5·5.)

HISTOLOGICAL APPEARANCES.—The maxillary anterior teeth were extracted and a part-denture provided to improve the appearance. Three of the extracted teeth, a maxillary central incisor, a lateral incisor, and a canine, were examined as unstained ground sections, and the other central incisor was decalcified and sectioned.

Enamel.—All three ground sections showed localized areas of gross hypoplasia situated in the cervical part of the crown and in the incisal one-third (*Figs.* 4 and 5). The cervical lesions consisted of a band of enamel occupying the cervical one-sixth of the crown, both labially and lingually, and was very thin, with an irregular surface and no recognizable enamel structure. It merged into the neighbouring enamel fairly sharply. The lesions in the incisal one-third of the crowns of these teeth were not uniform in character. All three teeth had the lingual enamel of this one-third very similar to the cervical band (*Fig.* 6) and again fairly clearly demarcated from the neighbouring enamel. On the labial surface the three teeth showed differences. On the canine there was a small "step" in the surface so that the incisal one-third was a little thinner than the rest. The surface was rather irregular but not severely so. In the second incisor in the incisal one-third (*Figs.* 5 and 7) the enamel was grossly affected, much as on the lingual surface with the exception of the tip where there was a small bulge of more normal enamel. The central incisor showed little hypoplasia in this area (*Fig.* 4), the surface being only slightly less regular than the rest of the enamel, but a break had occurred with a piece of enamel missing down to the amelo-dentinal junction with orange-brown staining of

the dentine just below and surrounding the space. It is clear that this is the edge of the carious cavity seen on the labial surface (*Fig.* 1). The decalcified sections of the other central incisor showed two enamel lamellæ in this area, passing right through the enamel.

Fig. 6.—Ground section of canine showing gross hypoplasia on the lingual surface. Enamel rods can be distinguished, but are for the most part cut transversely, and clubbed ends of the dentinal tubules can be seen. (×120.)

The enamel other than that directly associated with these areas of hypoplasia could be divided into three zones. Zone 1 was a very thin layer at the surface of the enamel, was amorphous in structure and relatively unpigmented (*Fig.* 5). Zone 2 lay under this and consisted of brown-pigmented enamel of various depths from two-thirds of the enamel thickness in the incisal one-third of the labial surface of the central incisor (*Fig.* 4), to quite a narrow irregular layer one-sixth to one-eighth of the total thickness of the enamel in areas of the lateral incisor and canine. This stained enamel layer extended throughout the three teeth, and only on its deeper side where the staining was less pronounced could the enamel rods be distinguished. For much of it the structure was unrecognizable, being obscured by the pigmentation. This brown staining varied in depth of colour from pale to very deep brown and almost black, and tended to occur in bands in the incremental pattern (*Fig.* 8). Zone 3 was the enamel deep to the stained layer and consisted of unstained enamel in which the structure could easily be seen. At the tip the enamel rods appeared fairly normal, but the incremental lines became more accentuated as one passed cervically, and in places the rod pattern became obscured by this.

Dentine.—The dentine appeared normal in all the three teeth examined in ground section. The interglobular spaces were within normal limits. Little secondary dentine was present, a finding consistent with the actual age of the patient rather than that suggested by the stage of development of the apices and the cementum (*see below*). One patch of secondary dentine was present in the central incisor and corresponded to an area of sparse enamel on the surface. The decalcified sections of the maxillary central incisor showed three very

Fig. 7.—Area "X" in *Fig.* 5. Area of the junction of the hypoplasia and the rest of the enamel on the labial surface. Prism structure can just be made out in the lower part of the section. (×120.)

Fig. 8.—Area "Y" in *Fig.* 4. Pigmentation tends to follow the incremental lines, which are shown slightly accentuated at the right of the picture. (×72.)

distinct interruption lines in the crown, and four others were less obvious.

Amelodentinal Junction.—In places this junction was normal, but the scallops tended to widen out and were lost under the more severe areas of hypoplasia as at the cervical margin and at the tip. Some of the dentinal tubules ended in club-shaped ends, presumably shortened or small spindles, only a few of which passed into the enamel (*Fig.* 6).

Cementum.—In all three teeth the cementum was acellular except near or at the apex. Here it was thickened and cellular, in places containing very coarse cellular elements. The quantity of cementum was more consistent with that found in a much older patient (*Fig.* 9). In the second incisor there were some resorption areas at the apex which had healed over with cementum.

Pulp.—This was normal.

DISCUSSION

It is evident from the clinical and microscopic examination of these teeth that the various features could not be explained under one simple heading, but that there were two types of defect existing in one individual. The first was a generalized condition of the enamel which appeared to be a hypocalcification. Except in certain well-defined areas the enamel matrix was well formed, with the reservation that the incremental lines were accentuated, especially in the later formed enamel. The severe pigmentation of the outer part of the enamel, the dull appearance, and advanced attrition all support the diagnosis of hypocalcification, the clinical picture being very typical of this condition. On clinical grounds this case is not a particularly gross type and would fall into Darling's Group 4A (1956) since there was little chipping of the enamel and the degree of staining in the mouth was comparatively mild. Darling showed that there was a layer on the surface which was better calcified than the main body of the enamel, and this could well be so here since there was a relatively unstained zone at the surface and beneath it the enamel, which was pigmented—a feature of hypocalcified enamel.

In addition to this generalized hypocalcification there appeared to be a disturbance of the formation of the enamel matrix in specific areas, the type of abnormality associated with severe systemic disturbances. These defects appear in a similar position in the time sequence of these teeth, i.e., at the tip of $\underline{2\ |23}$, part way down the crowns of $\overline{21|12}$, and probably at the tip of $\frac{4|\ 45}{|3}$. This period of development in the normal child corresponds to the age of 18 months to 2 years. The maxillary central incisors were not appreciably affected,

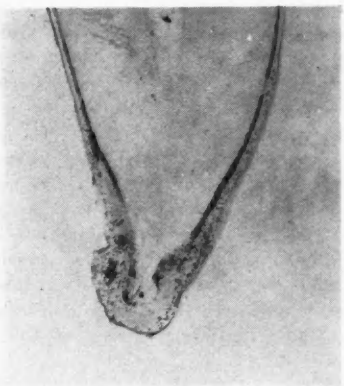


Fig. 9.—Ground section of the root of the central incisor showing the extent of the hypercementosis. (× 5·5.)

but it is a common occurrence that while teeth are usually affected bilaterally to a similar degree, they are often affected differently in different pairs of teeth developed at the same time. The cervical margin areas of the three teeth examined were all affected at a time in the normal child of 3–5 years. The medical history of the patient would tend to support the diagnosis of this type of hypoplasia, since it is known that there was an aortic stenosis, and that she was a poorly child "during the time her baby teeth came through", which would certainly cover the period of development of the incisal half of the anterior teeth. There is no history of any specific illness during the age 3–5 years, except the heart lesion. However, this is a period in the child's growth when the strain of the heart lesion would be felt particularly with the increase of physical activity, and the accentuation and irregularity of the incremental lines may be a reflection of this.

The time period covering these lesions has been suggested for the normal child, and this has been emphasized since the radiographic

and microscopic appearance is of advanced root development. There is no possibility of knowing whether the tooth development as a whole was precocious and therefore whether these time periods should be set much earlier in the child's life. If so, then the tip lesion could coincide with the premature birth—a demonstrated cause of hypoplasia in the deciduous teeth (Gråhnen and Larsson, 1958; Miller and Forrester, 1959) and the cervical lesion also re-timed a year or two earlier, possibly at 2–4 years. Brauer and others (1958) suggest that at this latter period the formative elements of the teeth are acutely susceptible to disturbances, and hypoplasias result from relatively minor ailments.

The hereditary aspect of the generalized hypocalcification is a very doubtful one. Certainly the child takes after her father in general likeness, and her Turner's syndrome is possibly attributable to a paternal defect of inheritance of sex. The only member of the family who might have had this enamel dysplasia was on the father's side, but one cannot go further than state the possibility in view of the lack of more definite evidence.

SUMMARY

A case is described in which there was a medical history of Turner's syndrome or ovarian short-stature syndrome, associated with aortic stenosis. Clinical, radiographic and histological evidence indicated that there was a generalized hypocalcification of the enamel with apparently an added hypoplasia of the periodic type, the latter having support from the medical history.

Acknowledgements.—I am most grateful to Dr. Marion Farmer of the Children's Clinic, Royal Victoria Infirmary, Newcastle upon Tyne, for the medical history. My thanks are also due to the staff of the Oral Pathology Department of the Sutherland Dental School for preparing the sections, and to the photographic department of the Newcastle upon Tyne Dental Hospital for the photomicrographs.

REFERENCES

BRAUER, J. C., DENERITT, W. W., HIGLEY, L. B., MASSLER, M., and SCHOUR, I. (1958), *Dentistry for Children*, 4th ed., 71. London: Kimpton.

DARLING, A. I. (1956), *Proc. R. Soc. Med.*, **49**, 759.

GRÅHNEN, H., and LARSSON, P. G. (1958), *Odont. Revy.*, **9**, 193.

MILLER, J., and FORRESTER, R. M. (1959), *Brit. dent. J.*, **106**, 93.

PERFORATION OF A MANDIBULAR THIRD ROOT MOLAR DIAGNOSED PRE-OPERATIVELY

By **J. R. PETTMAN**, L.D.S. (Dunelm.), D.Orth. R.C.S.

Registrar, Newcastle upon Tyne Dental Hospital

PERFORATION of a mandibular third molar tooth by the contents of the inferior dental canal is a well-recognized but relatively rare occurrence. On occasion (Austin, 1947), the presence of this anomaly has been diagnosed pre-operatively. In view of the recent survey by Howe and Poyton (1960) concerning the reliability of radiographic diagnosis in such instances, the following case is of interest.

CASE REPORT

A 68-year-old lady attended this hospital, complaining of inability to wear her lower denture owing to soreness in the left mandibular third molar region. She was clinically edentulous, but the muco-periosteum in the $\overline{8}$ region was inflamed and tender. No sinus was present in the area.

RADIOGRAPHIC EXAMINATION.—The patient was very deaf and extremely garrulous, so that it was not possible to obtain an intra-oral film. A lateral, oblique radiograph of the left mandible was taken with considerable difficulty. This film showed the presence of an unerupted, mesially-inclined, third molar tooth, whose occlusal surface was above the upper level of the adjacent bone (*Fig.* 1). Careful scrutiny of the radiograph revealed the presence of the three signs which are described by Howe and Poyton (1960) as being evident when "true relationship" exists between tooth and nerve. These signs are:—

1. A band of increased radiolucency where the inferior dental canal shadow crosses the tooth (Main, 1938; Durbeck, 1943).

2. The narrowing of the canal as it traverses the root (Lacronique, 1922; Austin, 1947).

3. The loss of radiopaque, linear shadows cast by the walls of the inferior dental canal as it lies in relationship to the tooth (Howe and Poyton, 1960).

It appeared from the radiographic evidence that the root was either deeply grooved or perforated by the neurovascular bundle.

OPERATION.—Under regional local anæsthesia, a large muco-periosteal flap was reflected, and bone was removed from the buccal aspect of the tooth with a bur. At this stage the tooth could be moved easily with an elevator, but, when gentle attempts were made to lift the tooth

Fig. 1.—Part of a lateral oblique radiograph showing $\overline{6}$.

from its socket with forceps, an elastic resistance was encountered and the patient complained of severe pain. No further attempt was yet made to deliver the tooth, which was then exposed more widely until it could be seen that the neurovascular bundle actually perforated the root (*Fig.* 2). The part of the root lying on the buccal side of the bundle was notched with a bur and divided by twisting an elevator in this notch. After the two pieces of tooth had been removed from the wound, the intact neurovascular bundle could be seen bridging the empty socket. A careful débridement of the wound was carried out. Hæmorrhage was minimal and the soft tissues were apposed by a loosely tied suture.

POST-OPERATIVE PROGRESS.—For the four days immediately following the extraction there was complete anæsthesia in the left side of the lower lip. This was followed by an intermittent itching sensation which lasted for a few minutes at a time. The patient said that on the tenth day the lip felt painful and enlarged, but she could not see any enlargement in the mirror. By the twenty-first post-operative day, sensation had returned to such an extent that the lip was slightly sensitive to pin-pricks. Subjectively, she complained of a "crawling feeling" in the lower lip for the next week. Six weeks after the operation the area of paræsthesia had reduced in extent and severity: at this stage it was impossible to demonstrate any impairment of labial sensation objectively.

DISCUSSION

Austin (1947) diagnosed his cases by interpretation of intra-oral, periapical films. Howe and Poyton (1960) describe signs in relation to intra-oral films. In the case recorded, "true relationship" of a mandibular third molar to the inferior dental canal contents has been diagnosed pre-operatively from an extra-oral film. In this instance, labial sensation returned to normal within six weeks, and, according to the criteria described by Miles and West (1954), the time factor indicates that the

Fig. 2.—The mesial aspect of the tooth showing the perforation. (Tooth reconstituted for the photograph.)

symptoms were caused by contusion and not by complete disruption of the nerve.

Pre-operative radiographic diagnosis enabled both the degree of trauma to the neurovascular bundle, and the resultant disability, to be minimized.

Acknowledgements.—I should like to thank Professor G. L. Howe for his criticism and help in preparing this report. Mr. A. J. Finlayson was kind enough to take the photographs.

REFERENCES

AUSTIN, L. T. (1947), *Amer. J. Orthodont.*, **33**, 623.
DURBECK, W. E. (1943), *The Impacted Lower Third Molar*. London: Henry Kimpton.
HOWE, G. L., and POYTON, H. G. (1960), *Brit. dent. J.*, **105**, 355.
LACRONIQUE (1922), *Rev. Stomat., Paris*, 704.
MAIN, L. R. (1938), *J. Amer. dent. Ass.*, **25**, 1993.
MILES, A. E. W., and WEST, W. H. (1954), *Dent. Practit.*, **4**, 370.

THE PERIODONTAL POCKET STUDIED BY THREE-DIMENSIONAL RADIOGRAPHY*

By **NILS BERGHAGEN** and **KURT BLOM**
Department of Dental Radiology, Royal Dental School, Stockholm, Sweden

THE periodontium is generally understood to comprise the cementum, the periodontal membrane, the bone of the alveolar process, and the gingiva. The pathologic condition that can arise in the marginal periodontium is known as marginal periodontal disease. This is usually characterized by chronic inflammation, which can gradually extend from the gingival margin to involve the deeper supporting structures and eventually result in destruction of the periodontium. The symptoms are almost invariably mild or non-existent, and the disease may be overlooked in its early stages unless a thorough examination of the whole dentition is carried out.

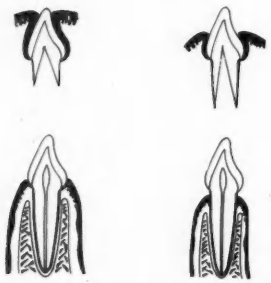


Fig. 1.—Normal gingival sulcus in different positions to the crown.

The pathologic deepening of the gingival sulcus (*Fig.* 1)—the periodontal pocket—is evidence of marginal periodontal disease and is often described as its cardinal diagnostic sign. It is necessary to distinguish between the soft-tissue pocket and the "bony pocket", or the "radiographic" pocket. Several methods of recording and measuring the depth of these pockets have been suggested, most of them based on subjective observations. The anatomy of the pocket and the difficulty of introducing a measuring instrument have, however, often resulted in mistaken descriptions. Radiographic methods have also been tried, but difficulties have been encountered, which have been due to, for instance, the low radiopacity of the soft tissues, and failure to observe the fundamental principles of photogrammetry when taking the radiographs. Inflammation of the gingiva, perhaps accompanied by the presence of periodontal pockets, may result in changes in the alveolar bone. The relationship between the extent of the pocket and the loss of alveolar bone varies considerably. Radiographs often misrepresent the relationship between the marginal alveolar bone and the teeth because of a wrong choice of film sensitivity, exposure time, or development technique. It is, however, of major importance to be able to make a proper examination of the state of the alveolar bone on the radiograph. The investigation reported in this article was designed to this end, and moreover, to develop the method by which the state of the alveolar bone, and especially the bony pockets, can be studied in three dimensions in the radiographs, for it is of great value in the clinic to be able to ascertain how many walls the intra-bony pocket has, the distance between them, and to study the surface of the bone.

Fig. 2.—Supra-bony periodontal pockets.

Fig. 3.—Intra-bony periodontal pockets.

* Presented to the British Society of Periodontology on April 6, 1960, as part of a Scandinavian Symposium.

CLASSIFICATION

On the basis of the relationship between the gingiva and the alveolar bone, periodontal pockets may be classified as *supra-bony pockets* (*Fig.* 2) and *intra-bony pockets* (*Fig.* 3);

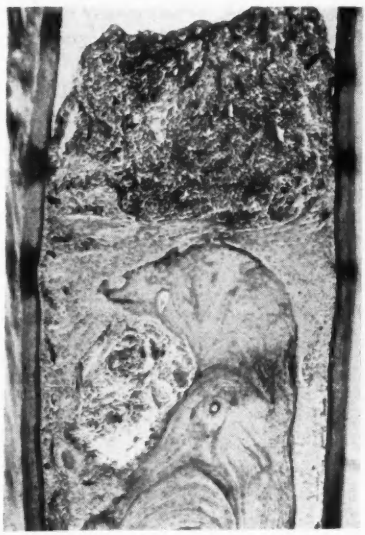


Fig. 4.—Histological picture of an intra-bony periodontal pocket.

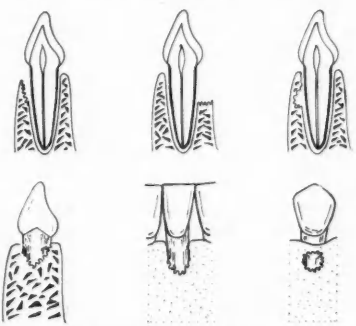


Fig. 6.—Simple bone cavities involving one root surface.

the former do not involve the bone (supra-osseous), whereas the latter are cavities in the bone itself (intra-osseous).

The bottom of the supra-bony pocket lies coronal to the crest of the alveolar bone but can be situated anywhere on the surface of the crown or the cementum. The periodontal pockets of this type may be divided into three sub-groups:—

1. Those which Goldman (1949) and Glickman (1955) call *relative* or *false pockets*, the bottoms of which lie at the cemento-enamel junction, and the deepening of which is due to gingival hyperplasia (*Fig.* 2). To this group

Fig. 5.—Radiograph of an intra-bony pocket.

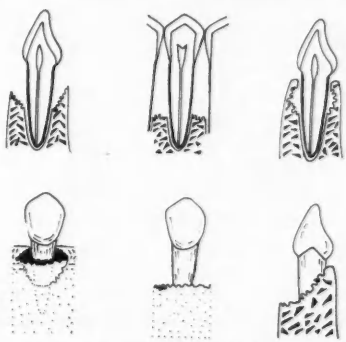


Fig. 7.—Compound bone cavities involving two or more root surfaces.

might be assigned the pockets that can occur in connexion with the eruption of the tooth (Westin, 1942).

2. Periodontal pockets, the bottoms of which lie apical to the cemento-enamel junction.

Here the deepening is due to destruction of the periodontal membrane and the alveolar bone and migration of the epithelial "cuff" or attachment along the root (*Fig.* 2).

3. A combination of these two forms (*Fig.* 2).

The bottoms of the intra-bony pockets are situated apical to the alveolar crest (*Figs.* 3–5).

RADIOGRAPHY

For radiologic examination of the state of the alveolar bone single radiographs are generally used. It is in this connexion that the terms horizontal and vertical bone destruction have come into currency—terms that do not reflect the true situation. Since marginal osteitis

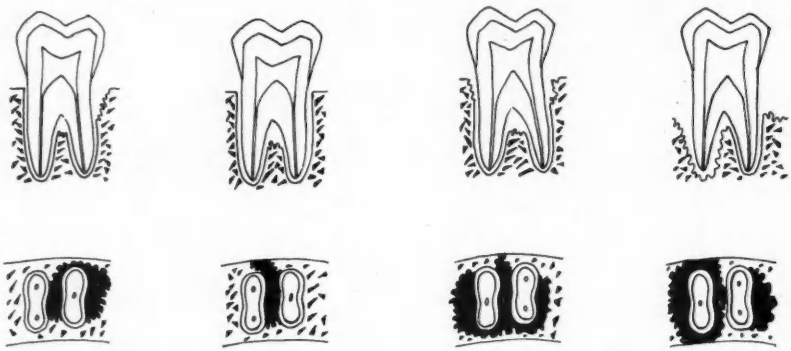


Fig. 8.—Composite cavities in the bone with complicated development involving the root surfaces of a lower molar. (Black = destruction of bone.)

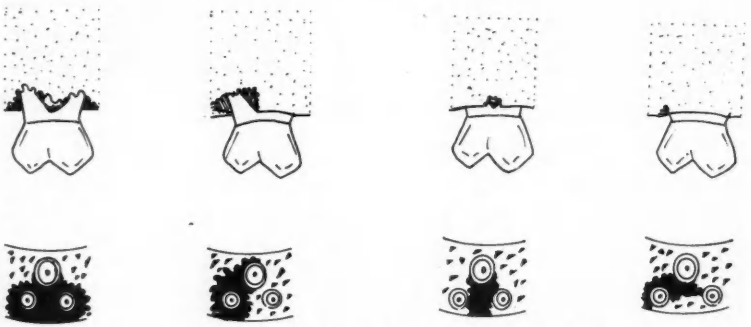


Fig. 9.—Composite cavities in the bone with complicated development involving the root surfaces of an upper molar. (Black = destruction of bone.)

They can be grouped according to the number of bone walls, 1–4, or according to the shape and extent of the bone cavity:—

1. Simple pockets involving one root surface (*Fig.* 6).

2. Compound pockets involving two or more root surfaces (*Fig.* 7).

3. Complex pockets, which follow a tortuous course around or between the roots involving one or more surfaces (*Figs.* 8, 9).

spreads along the path of least resistance there will never be a purely horizontal or vertical resorption. For correct visualization at least two single radiographs of the area in question should be taken—for instance, one ortho-radial and one mesio- or disto-eccentric, so that the effect of parallax can be exploited to place the various details in their correct three-dimensional relationship. Parallax can be either horizontal or vertical. Two radiographs that

give only horizontal parallax, which is preferable, can be used for direct three-dimensional viewing. If, on the other hand, horizontal and vertical parallax occur simultaneously, such an examination is rendered difficult if not impossible. The "normal case" should therefore be aimed at when taking the radiographs, and in order to achieve this some kind of fixed system is required, and a systematic technique must be applied. Most radiographs are, however, taken by the free-hand technique according to the bisector rule of Dieck-Cieszynski or by the "bite-wing" or "long-cone" methods. The most accurate impression of the relationship between the alveolar crest and the root of the tooth is probably obtained with the last two of these methods.

Some interesting studies in this field have been carried out by Herulf (1950), who took radiographs of the marginal alveolar bone in a group of students, some of them "apical pictures" taken according to the bisector rule and the others "collum pictures" with the central beam incident on the neck of the tooth. On measuring the distance between the cemento-enamel junction and the alveolar crest in each case, a significant difference between the values given by the two techniques was obtained. The distance was 0·33 mm. greater for the collum radiographs. Herulf considered that the collum technique gave an accurate impression of the structure in this region.

Orban and Orban (1960) have reported a study in which they took three radiographs of the interdental alveolar septum at $+25$, 0, and $-25°$ to the vertical. By studying these radiographs the operator might "construct in his mind" a three-dimensional view of the marginal crest, and so obtain a clearer conception of the pathologic status. They did not use their radiographs for direct three-dimensional examination.

It is, however, proved from the authors' research that the most accurate picture of the object is obtained from stereo-radiographs taken in accordance with photogrammetric principles. In dentistry there is need for a sound radiological method for following physiological and pathological processes in the jaws. Investigations have been published where the healing processes have, it is claimed, been followed by serial identical radiographs. A photogrammetric check of such radiographs shows, however, that they are seldom identical, but present irregular parallaxes. Nevertheless, the pictures have been accepted hitherto as being near enough identical for clinical purposes. But it is incorrect to refer to them as serial identical radiographs. In an attempt to find a method of obtaining comparable radiographs Berghagen (1951) has designed an apparatus for attachment to the dental X-ray machine which enables one to take stereo-radiographs on which photogrammetric measurements can be made. This apparatus has been used for some 10 years at the Royal School of Dentistry in Stockholm. There follows a brief description of its design.

PHOTOGRAMMETRY

Photogrammetry is the science of mensuration of the photographic image. In the design of Berghagen's apparatus certain basic photogrammetric principles have been applied. A few definitions of photogrammetric terms and concepts will be given as an aid to the understanding of the apparatus.

As in photography, in radiography the image is obtained by a central projection. This is characterized by the fact that the straight lines joining the points on the object to the corresponding points in the image all pass through one point, the centre of projection. In radiography the focus is the centre of projection (*Fig.* 10). The rays forming the image compose the ray cone. The *inner orientation* comprises those elements that define the shape of the central projection, and this is determined by the relative position of the focus and the image plane. It is convenient to state the distance between the focus and the image plane and the position of the point of intersection of the normal from the focus and the image plane. When radiographs are being used for purposes of control the position of the focus in relation to the object and the bundle of rays must be known. This relationship is

denoted as the *outer orientation*. When taking serial identical radiographs it is essential that the outer orientation shall be unchanged or reconstructable. Base, relative orientation, and

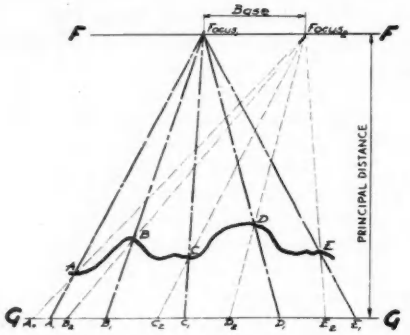


Fig. 10.—Three-dimensional radiography.
G—G = film plane.
A—E = object. $Focus_1$— $Focus_2$ = base distance.
$Focus_1$, $Focus_2$ = two positions of focus.
F—F = direction of base parallel to film plane.
$Focus_1$—A_1—E_1, $Focus_2$—A_2—E_2 = two ray cones.

absolute orientation are other terms that have application in stereo-radiography.

The *base* is the distance between the two positions of the focus, in which the pair of exposures are made.

The *relative orientation* is determined by the relative position of two associated ray cones.

The *absolute orientation* is determined by the scale and position in space of the photogrammetric model.

The inner orientation is sometimes expressed in terms of the angles of projection, but when the free-hand technique is used there is no guarantee that the angle will not change during the period of exposure through movement of the patient or the X-ray apparatus. It is also recommended sometimes to place the film parallel to the object, but this is impossible since the object is not a plane figure but a three-dimensional one. *The important thing is to place the object between the film plane and the focus so as to provide the best view, to take the radiographs in accordance with the rules of photogrammetry, and to use a calibrated X-ray machine.*

APPARATUS FOR INTRA-ORAL RADIOGRAPHY

The apparatus, the description of which follows, was designed to fulfil the following requirements:—

1. The film should be plane.
2. The inner orientation should be known.
3. The outer orientation should be reconstructable for single radiographs.
4. The relative orientation and the base should be known for stereographic treatment.
5. A special diaphragm should be incorporated which would ensure that only the area of the film to be used is exposed.

The film can be kept plane by using a plane film-holder. The inner orientation must be determinable from measurements performed on one occasion, and this should serve for all subsequent exposures. There must be a fixed mechanical connexion between the film-holder and the focus. For the outer orientation to be reconstructable the film must be placed on each occasion in an identical position in relation to the object and this may be effected by means of an impression of the teeth taken in compound affixed to the film-holder.

Apparatus.—The unit consists of two principal components: the film-holder and a clamping device by which it is fixed to the X-ray machine in the desired position in relation to the central ray (*Fig.* 11).

The clamping device consists of a frame (1) cast in light metal, in which a thin steel cylinder (4) is fitted; within this a short tube (5) is loosely fitted; this has two studs (6) corresponding to the bayonet attachment (7) on the X-ray machine. On the other end of the tube is threaded a knurled ring (8) by which the unit is securely fastened to the X-ray tube.

The film-holder, consisting of the actual holder (18), the impression compound carrier (16), and the bracket (19), is of metal. It is fixed to the clamping device through a metal rod (3), the end of which is circular in section; this is the film-holder arm. The arm has a cylindrical cross-piece (13) to which the bracket is secured by a bolt and a set screw (17, 15). The head of the bolt is in the form of a disk

(14), bearing an engraved scale which enables the film-holder unit to be rotated through a known angle.

The other end (10) of the rod is square in section and is clamped in one of seven horizontal grooves (9) by a bridge (11) and two screws (12).

The dimensions of the film-holder are such that it will take the film. The lateral edges of the plate are bent to form a frame in which the film can be inserted and held firmly. The edges serve as reference lines on the radiographs and have notches—"frame marks"—as reference points. The film-holder is set at an obtuse angle to the impression compound carrier (19), on the upper and lower surfaces of which the impression compound is placed.

When the tray, film, and impression compound are introduced into the mouth the patient is required to bite on the plate so that an impression of the teeth is obtained that will enable the tray to be replaced in the same position after the film has been changed.

The bracket is bent at right angles to the impression compound carrier. On the bracket a small cone (20)—the symmetrical reference cone—is fastened centrally in relation to the film-holder. The bracket is bent either to the right or to the left so that the compound carrier may be used in the lateral regions of the mouth. With the left bend the tray covers the region from the left canine to the right third molar in both jaws, while the corresponding teeth on the right are reached by the tray with the right bend. The film-holder unit can be rotated about the bolt (17) and can be locked by tightening the screw (15). The angle can be read on the engraved scale. The tray is easily removed.

To reduce the secondary radiation, which decreases the definition of the image, the X-ray machine is provided with a special shielding

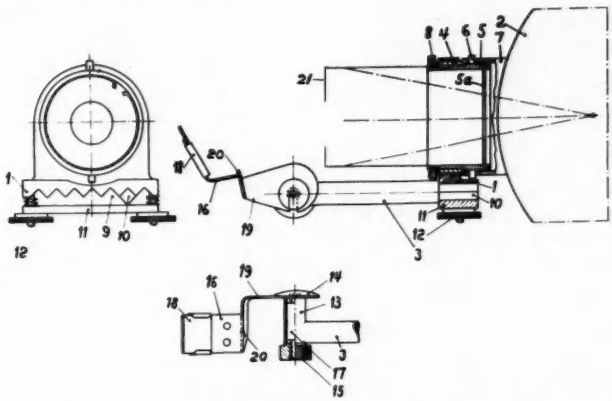


Fig. 11.—A diagram of the authors' apparatus for taking stereoscopic intra-oral radiographs.

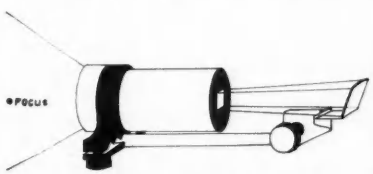


Fig. 12.—Shielding device for reduction of secondary radiation.

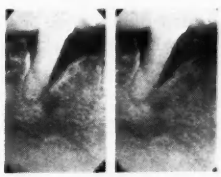


Fig. 13.—Stereo-radiographs of an isolated tooth with a crater-like defect in the alveolar bone. Viewed orthoscopically.

device (21) which ensures that only the area corresponding to the film will be exposed to the rays (*Fig.* 12). In this way the X-ray dose is greatly reduced.

Application.—As has been mentioned in the introduction, a radiographic study of the alveolar crest, and particularly its interdental and inter-radicular parts, is of great value in diagnosis and therapy. The areas and details in question are so small, however, that parallel displacement by the free-hand technique does not always give acceptable results; on the other hand, the described technique is highly reliable in this respect.

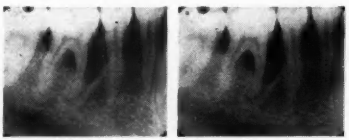


Fig. 14.—Stereo-radiographs of $\overline{7\text{–}3}|$ region viewed pseudoscopically.

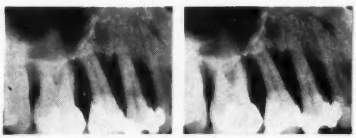


Fig. 15.—Stereo-radiographs viewed pseudoscopically to show extensive vertical bone loss.

An account will be given of nine selected cases of progressive periodontal disease where radiographs were taken by this technique so that a three-dimensional examination could be performed. The base was 10 mm.—that is to say, the focus was moved 10 mm. parallel to the film plane between exposures (the "normal case"). The radiographs were studied singly and as stereo-pairs, and in the latter case with both orthoscopic and pseudoscopic viewing. Comparison could be made directly with the single radiographs, and where the reproduced stereo-pairs are insufficiently clear, reference can be made to the comments relating to each pair. (The definition of the published pairs may have been reduced through the printing procedure.)

Fig. 13 shows an isolated tooth surrounded by a crater-like defect in the alveolar bone. The density gives an impression of the thickness of the wall. From the single radiographs it is not possible to establish the shape of the cavity, the thickness of its walls, or whether it is the lingual or buccal wall, or both.

When viewed stereoscopically, however, there is a clear improvement in definition and the positions of the various points in space are more clearly brought out, though there are, of course, no more details visible than are to be found on the single pictures. On the mesial side there is a vertical bony cavity which has no lingual wall and which ends apically in a slight widening of the periodontal space. On the buccal aspect the cavity has a wall containing some fine pores. Marginally, the cavity continues up to the border, which is slightly hollowed out and has a somewhat higher buccal edge. Between the border and this cavity the buccal wall is more porous. The mesial cavity continues into another cavity buccal to the root and then into a smaller distal cavity. This also has no lingual wall and meets the crista border at a sharp angle. Lingually, about two-thirds of the root has no attachment to the bone. There is no bony cavity here.

Fig. 14 shows the alveolar bone in the region $\overline{7\text{–}3}|$. On the single radiograph there is a well-defined border, which gradually falls from the region of the $\overline{3}|$ to the mesial side of the mesial root of the $\overline{6}|$ a short distance from the apex. The border then rises, rather diffuse in outline, towards the interproximal space between the $\overline{6}|$ and $\overline{7}|$ and passes immediately below the bifurcation of the $\overline{6}|$. In the region of the $\overline{4}|$ and $\overline{5}|$ there is an area of low contrast and the interproximal spaces in the region $\overline{6}|$ to $\overline{3}|$ gradually increase in density. If the stereo-pair is viewed pseudoscopically, that is to say from the lingual side, one can see into the interproximal spaces $\overline{7\text{–}3}|$, since the lingual wall is missing. The lingual border gradually falls from the distal part of the $\overline{3}|$ to the mesial root of the $\overline{6}|$, where the loss of bone is most pronounced. In this region the buccal wall remains partly as a thin lamina and extends past the $\overline{5}|$. On both the buccal and the lingual sides the border rises until at the $\overline{7}|$

it is at practically the normal level. The bony cavity in the interproximal space between the $\overline{5}|$ and $\overline{6}|$ has a fairly even bone surface towards the $\overline{5}|$. The periodontal space on the distal aspect of the $\overline{5}|$ is normal in width.

Fig. 15 is of the region $\overline{7\text{–}3}|$. The single radiograph shows vertical bone destruction throughout the region $\underline{54}|$, and the buccal

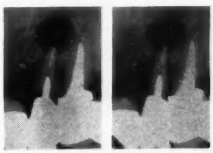


Fig. 16.—Stereo-radiographs viewed pseudoscopically to show irregular marginal bone loss mesial to $\underline{2}|$ and a periapical bone cavity.

roots of the $\underline{6}|$ are weakly supported. It is evident from the density that there must be a difference in level between the buccal and lingual borders. No spatial features can be recognized when the radiographs are viewed singly. When viewed orthoscopically as a stereo-pair, it is evident that the cavities in the bone between the $\underline{4}|$ and $\underline{5}|$ and between the $\underline{5}|$ and $\underline{6}|$ have buccal walls that cover two-thirds of the height of the root. The cavity between the $\underline{3}|$ and $\underline{4}|$ has no buccal wall. Pseudoscopic viewing reveals that except for the cavity between the $\underline{3}|$ and $\underline{4}|$ there is no lingual wall. Similarly, the buccal roots of the $\underline{4}|$, $\underline{5}|$, and $\underline{6}|$ are very weakly supported on the oral side; there are, however, no cavities. The cavity between the $\underline{5}|$ and $\underline{6}|$ extends in between the buccal and palatal roots. The bony septum in the region $\underline{54}|$ is very jagged and porous. Except for the bone in the region $\underline{43}|$, the bone surfaces are very porous.

Fig. 16 relates to the region $\overline{3\text{–}1}|$. In the study of the single radiographs it is found that the marginal border in the region $\overline{21}|$ is "ragged" and provides support for the $\overline{2}|$ only in a small area near the apex. The residual periodontal spaces are widened, and in the apical region there is a well-defined pea-sized area of lower density. In a few places the bone contains small dense bodies. At the border of the crown of the $\overline{2}|$ there is a fairly dense area. The $\overline{3}|$ has a slightly stronger bone attachment, but there is an area of high density distally on the edge of the crown. The periodontal space is widened. When the stereo-pair is viewed pseudoscopically—that is, from the palatal side—it is immediately evident that the roots of the $\overline{2}|$ are located slightly labially to the $\overline{3}|$. Defects in the

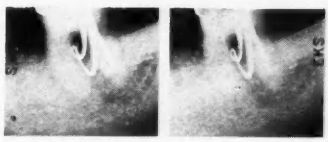


Fig. 17.—Stereo-radiographs of a lower molar with gutta-percha points in place in the periodontal pockets. Viewed orthoscopically.

cementum are visible on the cervical parts of the $\overline{2}|$ and $\overline{3}|$. The alveolar crest is very jagged and porous. It falls towards the apical region of the $\overline{2}|$ and a cavity on the labial side of the tooth extends right to the apex. Palatally, on the other hand, the tooth is still anchored in bone. The cavity continues also on the labial side of the root of the $\overline{3}|$, which has a fairly large attachment on the lingual aspect. Around the apex of the $\overline{2}|$ there is a pea-sized bony hollow that has no lingual wall and the apex projects into the space. The position of the foreign bodies is easily determined.

Fig. 17 shows an example of an interradicular cavity. When the pair is viewed orthoscopically the position of the two bent root filling points in the cavity is easily seen and it is evident that the buccal wall has disappeared. The bone attachment is wider and slightly lower on the distal than on the mesial root.

Fig. 18 shows the region $\overline{5\text{–}3}|$. Viewed pseudoscopically two roots of the $\overline{4}|$ are clearly visible. In the palatal root there is a pin and apically to this a dense mass. In the apex there is a perforation through which excess root-filling material has evidently been pressed. In the buccal root there is a very dense body, part of which has penetrated the slightly resorbed apex. Around the two roots, but with the main part on the buccal side, there is a

pea-sized defect in the bone. There is no lingual wall and only a very thin buccal one. On the mesial side a widened periodontal space leads into a cavity in the alveolar crest, the surface of which is slightly porous and jagged. The $\overline{3}|$ has a bony attachment that extends about one-half the way along the root. There is no cavity, but a widening of the periodontal contour.

Fig. 19 relates to the region $\overline{7\text{–}4}|$. Viewed pseudoscopically the stereo-pair shows a cavity between the $\overline{5}|$ and $\overline{6}|$; its buccal wall is practically intact whereas the lingual wall is

Fig. 18.—Stereo-radiographs which give a far better picture of the cavity around the $\underline{|2}$ root than any single view could. Viewed pseudoscopically.

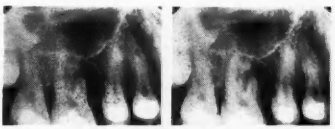


Fig. 19.—Stereo-radiographs viewed pseudoscopically to show the form of the vertical bony defect mesial to $\underline{6}|$.

Fig. 20.—A pseudoscopic view of a pair of stereo-radiographs.

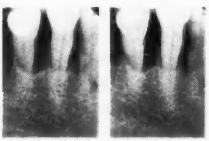


Fig. 21.—Stereo-radiographs showing the form of the bony cavity around $\overline{4}|$. Viewed pseudoscopically.

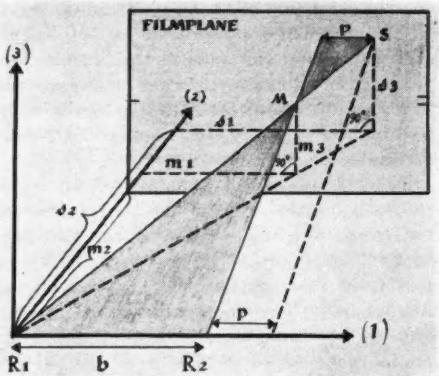


Fig. 22.—The co-ordinate system consists of three mutually perpendicular cones (1), (2), (3) with origin at the focus R_1, (2) perpendicular to the film plane, and (1) passing through focus R_2. The ray from R_1, which represents a certain point on the object, contains the two vectors M and S, which have their origin in R_1 and end at the object and image point respectively. (M and S in the figure are at the ends of the respective vectors.) This arrangement is expressed vectorially by the formula $M = \mu s$ where μ is number representing the relationship between the lengths of M and S. (*See also Svensk tandläk.-T.* (1954), **47**, 135.)

completely absent. The wall contains some small pores. Towards the $\overline{5}|$ there is an even wall, but towards the mesiobuccal root on the $\overline{6}|$ there is no bone at all. The cavity encompasses the mesiobuccal root and extends down towards the apex. The central part of the septum between the $\overline{6}|$ and $\overline{7}|$ is partially destroyed. In this region there is no wall towards the lateral parts of the $\overline{6}|$ and $\overline{7}|$. The distal surface of the $\overline{7}|$ has no wall next to the occlusal surface of the partly visible third molar. The bony septum between the $\overline{4}|$ and $\overline{5}|$ has sunk slightly, and there is a very small shallow concavity which inclines towards the $\overline{4}|$ in the apical direction. The top of the bony septum between the $\overline{4}|$ and $\overline{3}|$ is partly resorbed.

Fig. 20, viewed pseudoscopically, shows that the alveolar crest is markedly sunken. The bone is highly porous, especially distally to the $\underline{5}|$. At the centre the bony septum between the $\underline{5}|$ and the $\underline{4}|$ is resorbed. The buccal border is higher than the lingual one. The $\underline{5}|$ has a bony attachment only in the apical

part. The septum between the 4| and the $\overline{3}$| is porous.

Fig. 21, viewed pseudoscopically, shows a lowering of the alveolar crest to one-half the height of the root in the region of the $\overline{3}$| and $\overline{4}$|. On the mesial side of the $\overline{4}$| there is a

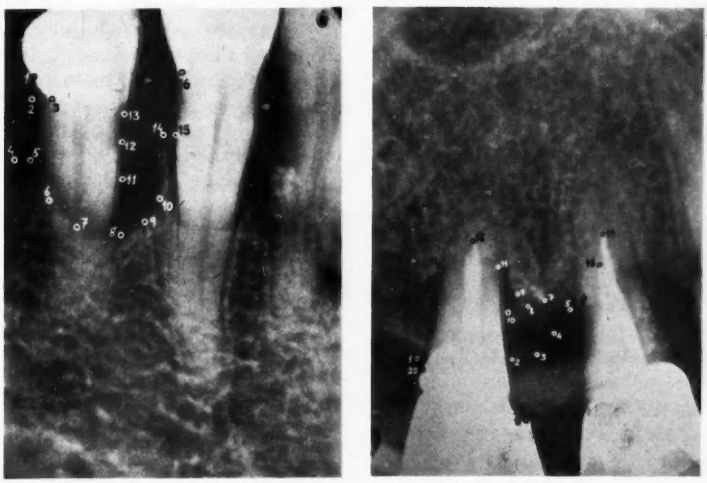


Fig. 23.—A series of numbered points marked on the radiographs can be used to compare the stereo-pairs and for topographic description of the bone cavities.

funnel-shaped defect with a buccal wall which lies more coronal than the lingual one. The mesial attachment of this tooth has been lowered, but there is no cavity. The septum between the $\overline{3}$| and $\overline{2}$| is partly resorbed. The most severe resorption is found lingually; on the buccal aspect the wall is almost intact.

DISCUSSION

The value of a radiological examination in cases of periodontal disease is now widely realized. Moreover, that a full mouth series is required is evident in view of the diffuse mode of extension of rarefying marginal osteitis and the value of recognizing the less obvious signs that enable the dentist to plan his therapy. It should, however, be borne in mind that while an X-ray check can supplement the clinical examination, it can never replace it. What can the dentist learn from single radiographs? They will usually show whether any bone has been resorbed, and usually the type of destruction—horizontal, vertical, or lacunar, for instance. It is, however, not so very important to know how much bone has disappeared, but it is of great value to note the position and appearance of the residual marginal bone, the structure of the surface, the shape and extent of the bony cavity, and the presence of any inter-radicular changes. Not all these features are readily observed on single radiographs, and therefore stereo-radiographs constitute a great aid, for they will add greatly to the definition and clarity as well as bring out details that were not recognizable on the single pictures. Not only interdental cavities but also buccal, lingual, and inter-radicular ones are rendered visible, and that is an important advantage in making a choice of therapy and a prognosis. By using both orthoscopic and pseudoscopic viewing the definition of the sharpness is considerably increased. When examining an interdental pocket with, for instance, only the buccal wall left, pseudoscopic viewing provides an impression into the cavity which is not obtained by an orthoscopic examination. If, instead, only

the lingual wall is present, then the contrary applies.

For ordinary clinical use the X-ray machine need not be calibrated, because no measurements need be made. It is sufficient to compare the stereo-radiographs taken on different occasions only from the direct stereoscopic aspect. Nor are serial identical radiographs required, and hence no impressions need be prepared.

In scientific work, however, a calibrated system is essential. The radiographs can then be placed in a known co-ordinate system (*Fig.* 22) and the co-ordinates of the different points on both object and image can be measured. From the measurements different distances and angles in the object can be calculated. The co-ordinates of the object points can also be used for a topographic description of the cavities (*Fig.* 23) and for drawing contours. It is, of course, not always possible to obtain ideal results. The "shadow" nature of the radiographic image can often result in a certain degree of uncertainty in the mensuration values. By means of the special diaphragm, practically all the X-rays will be incident on the film so that the patient is exposed to the minimum dose. This, in combination with a systematic method of radiography, ensures optimal results with the least number of exposures.

SUMMARY

Periodontal pockets can be classified as supra-bony pockets and intra-bony pockets; the former do not involve the bone whereas the latter are cavities in the bone itself. Stereo-radiography provides a valuable aid in choosing therapy and making a prognosis in cases of periodontal disease. It is essential, however, that a systematic procedure based on photogrammetric principles is followed so that accurate stereo-pairs of the alveolar bone can be obtained.

To reduce the risk from secondary radiation a special diaphragm has been designed which ensures that all rays are cut off except those incident on the film, thus enabling the X-ray dose to be considerably reduced and the sharpness of the details to be increased. This is effected by eliminating blur due to movement, since the focus, object, and film plane are fixed in relation to one another during the exposure and by using stereo-viewing. The three-dimension examination is particularly valuable in diagnosis of intra-bony cavities which extend in between the roots of multi-rooted teeth.

Orthoscopic and pseudoscopic viewing will give better sharpness of detail. If a calibrated X-ray machine is used measurements can be performed on the radiographs in order to evaluate the results of treatment. Similarly topographic description of the bony cavities can be obtained.

BIBLIOGRAPHY

BERGHAGEN, N. (1951), Photogrammetric Principles applied to Intra-oral Radiodontia. Thesis, Stockholm.
— — and HJELMSTRÖM, P. (1956), *Acta odont. scand.*, **14**, 189.
— — — — (1956), *Ibid.*, **14**, 221.
GLICKMAN, I. (1955), *Clinical Periodontology*. Philadelphia and London: W. B. Saunders Co.
GOLDMAN, H. M. (1949), *Periodontia*. London: H. Kimpton.
GOLDMAN, H., and COHEN, W. (1958), *J. Periodont.*, **29**, 272.
HALLERT, B. (1958), *Trans. roy. Inst. Tech.*, 123.
— — (1960), *Photogrammetry: Basic Principles and General Survey*. New York: McGraw-Hill Book Co.
HERULF, G. (1950), *Svensk tandläk. Tidskr.*, **43**, 2.
NORBERG, O. (1934), *Ibid.*, **27**, 1.
ORBAN, THOMAS R., and ORBAN, BALINT J. (1960), *J. Periodont.*, **31**, 275.
WESTIN, G. (1942), *Z. mikr.-anat. Forsch.*, **51**, 393.

Histological and Histochemical Observations regarding Early Calculus Formation in Children and Adults

Calculus was collected on cellulose acetate strips which had been adapted to the lingual surfaces of the mandibular incisors of 74 persons whose ages ranged between 5 and 70 years, for a period of 30 days.

It was found that calculus was deposited on the strips in the mouths of children where it did not deposit under normal conditions.

Deposition on the strips was less rapid in children than in adults, but presented the same histological and histochemical features.—TURESKY, S., RENSTRUP, G., and GLICKMAN, I. (1961), *J. Periodont.*, **32**, 7.

B. WADE

BOOK REVIEWS

GENERAL ANÆSTHESIA FOR DENTAL SURGERY. By R. S. WALSH, M.A., B.M., B.Ch., F.F.A.R.C.S., First Assistant, Department of Anæsthetics, St. George's Hospital, London, and the Southampton Group of Hospitals; lately Anæsthetic Registrar, The Royal Dental Hospital of London. $8\frac{1}{2} \times 5\frac{1}{2}$ in. Pp. 94+ix. Illustrated. 1960. London: Longmans, Green & Co. Ltd. 21s.

THIS is a small but valuable book written for general practitioners of medicine and dentistry, but so well is the subject of general anæsthesia at the chair-side covered, that all trainee anæsthetists and any dental surgeon who prefers to operate on an unconscious patient should read it.

Dr. Walsh gives an up-to-date account of the merits and limitations of the drugs and techniques which he considers wise and safe to use. A working knowledge of the contents of such a monograph would prevent a recently qualified dental surgeon from asking the "impossible" of his anæsthetist.

The first two chapters deal with physiology and pharmacology. Theoretical considerations are related to practical techniques: for example, the sensation of suffocation depends on impeded respiration and not on the oxygen content of the inspired gases. The fallacy of attempting to give nitrous oxide under pressure is exposed, and any apparent benefit from closing the expiratory valve on apparatus is explained by the fact that the patient cannot suck in air around a badly fitting nose-piece.

Inhalation methods could have been contrasted with the intravenous route, for after an overdose of inhalation anæsthetic the patient stops breathing and takes in no more, but with a needle in a vein there is nothing to stop an inexperienced practitioner giving an overdose in the presence of respiratory arrest.

Five chapters deal with all the practical problems of giving the anæsthetic and handling the patient in the dental chair: much helpful advice is given, and no criticism of mine is intended to detract from their valuable content. It is suggested that a patient who breathes through the mouth during induction can be forced into nose-breathing by covering the mouth with a hand "sufficiently firmly" to stop air leaks. It is possible to suffocate even an adult with a heavy hand, and having done it once, the anæsthetist will use a mouth cover with a gas supply as the answer to persistent mouth-breathing during induction.

While the necessity for the use of a throat-pack is stressed, insufficient warning is given that the position of the pack is a dual responsibility of operator and anæsthetist. The death of a patient caused by the inhalation of a throat pack has been held by the Court of Appeal to be negligence by both operator and anæsthetist. Peace of mind can be obtained by using a pair of artery forceps to "tail" the end of the pack if only a few inches remain outside the mouth.

In the excellent chapter on children it is advised that if a child will not tolerate a dental prop before induction with nitrous oxide it is of little importance as it may be inserted later. The words "with difficulty" might well be added to this statement, for the author gives a reason on the following page—children are asleep in five breaths, anæsthetized in ten, and violently jactitating in fifteen.

Dr. Walsh gives sound and helpful advice on the use of intravenous thiopentone (Pentothal) to subdue the resistant patient. He has omitted to mention the importance of questioning the patient for pain at the site of injection. In a patient with fat arms, the needle may have to be inserted into a vein which can be felt but not seen: even when using dilute solutions of thiopentone the patient must be asked to confirm that the injection is causing no pain.

The chapter on the assessment of fitness of a patient is full of common-sense advice and

points the way to questions of medical history which are relevant when the safety of giving a particular patient an anæsthetic in the dental chair is in doubt.

There can be few dental surgeons and general medical practitioners who will not pick up some valuable advice or practical tips from reading this book: such knowledge when put into practice will not only make for the welfare of the patient but improve the operating conditions for the dental surgeon.

W. S. McC.

ENDODONTICS. The Postgraduate Dental Lecture Series. By HARRY J. HEALEY, A.B., D.D.S., M.S.D., F.A.C.D., Chairman, Division of Endodontics, Indiana University School of Dentistry. $7\frac{5}{8} \times 4\frac{3}{4}$ in. Pp. 370, with 149 illustrations. 1960. St. Louis: The C. V. Mosby Co. (London: Henry Kimpton). 58s.

IN the foreword it is stated that: "This book should guide Dental Students and Practitioners to a more complete comprehension of details of Endodontic techniques and a knowledge of how Endodontics fits into the practice of dentistry." This aim is achieved in the fifteen chapters of the book.

Dr. Healey has included six chapters written by others and this has resulted in unbalancing the subject. For example, 53 pages are devoted to a chapter on prescription writing and systemic medication, including conversion tables from the apothecaries to the metric system of weights and measures, and 45 sample prescriptions. On the other hand, only 21 pages are devoted to tie instrumentation of the root canal and of these 6 pages are given to describing the construction of a "do-it-yourself" incubator, including the cost (in dollars) of the various components.

The book commences with comprehensive chapters on the diagnosis of toothache, the associated pathology, and selection of cases for root-canal treatment. In this section a detailed description of root-canal anatomy would be useful. Four methods for filling root canals are described in detail, but no mention is made of recent continental methods which have proved popular in this country.

The concluding chapters deal with bleaching discoloured teeth, surgical intervention associated with endodontic therapy, treatment of fractured incisors, replantation, and the permanent restoration of the non-vital tooth.

The book is well illustrated throughout and is printed on good quality paper. The reader is given a very adequate survey of current American thought on endodontics, and further detail may be obtained from the references at the end of each chapter. A. H. R. R.

THEORY AND PRACTICE OF CROWN AND BRIDGE PROSTHODONTICS. By STANLEY D. TYLMAN, A.B., D.D.S., M.S., F.A.C.D., Professor of Prosthetic Dentistry and Head of the Department of Crown and Bridge Prosthodontics, University of Illinois College of Dentistry, Chicago, etc.; and STANLEY G. TYLMAN, B.S., D.D.S. Fourth Edition. $9\frac{3}{4} \times 6\frac{3}{4}$ in. Pp. 1063, with 1474 illustrations and 11 coloured plates. 1960. St. Louis: The C. V. Mosby Co. (London: Henry Kimpton). 131s. 6d.

SINCE 1940 this text-book has become the accepted reference book and guide to those interested in crown and bridge work. No other volume covers so fully and in such a detailed manner the practice and theory of this branch of dentistry.

This, the fourth edition, still maintains the same high standard of information regarding those techniques which are considered useful in both the specialist and general practice. Dr. Tylman keeps up with the times by including new chapters dealing with the properties and manipulation of the silicone and rubber base impression materials. Also included are new sections on the techniques of high-speed tooth cutting and direct porcelain to gold restoration, as well as a chapter on procedures for registering and recording functional jaw relationships.

No words are required to describe the value of this book to either teachers of operative dentistry or practitioners, because each edition has proved itself to be a further outstanding contribution to conservative dental literature.

D. D. D.

ABSTRACTS FROM OTHER JOURNALS

Use of Polyvinyl Alcohol Sponge in Alveoloplasty, a Preliminary Report

Thin, sharp, and undercut mandibular ridges present a major problem to prosthetists. Removal of sharp points is only partially successful and relieving the denture does not prevent their recurrence. Gelatin sponge is not a success as a material for filling the undercuts as it is absorbed.

In an attempt to eliminate undercuts, to widen the alveolar process, and to provide a shock absorber, polyvinyl alcohol sponge (Ivalon) has been implanted. It is hoped that ultimately bone formation might be encouraged. The techniques for sterilizing, cutting, and moulding it are described. It excites little inflammatory response, is rapidly invaded by connective tissue, and seven patients have been treated with it to date. Experiences with four of these are reported.

An incision is made away from the area to be grafted and a mucoperiosteal flap raised. The ridge is smoothed and a suitably shaped piece of sponge is sutured into place with stitches which transfix the alveolar process. The wound is meticulously closed. In some cases a marked post-operative œdema may occur, but 6 weeks later impressions may be taken, as by this time the ridge is firm in consistency, and no subsequent change in shape has been observed up to 2 years. If part of the graft becomes exposed, a piece can be excised and successful wound closure obtained.

The graft is infiltrated and surrounded by a tough, fibrous tissue. Unless exposed to the mouth, no inflammatory infiltration is seen, but many giant cells surround the graft, so ultimate absorption cannot be excluded.—EPSTEIN, J. L. (1960), *J. oral Surg.*, **18**, 453.

G. R. SEWARD

Healing of Surgical Extraction Wounds in Macacus Rhesus Monkeys: The Effect of Burs

Forceps extractions are rapidly performed and result in little damage to the gingival tissues or the alveolar process. If surgical methods are used either burs or chisels are commonly employed for bone removal. In this series of experiments mucoperiosteal flaps were reflected on the buccal or labial aspect of the teeth and bone removed with a bur until the extractions could be easily completed. The flaps were replaced and sutured. A histological examination of the sockets was made after intervals varying from 3 days to 8 weeks.

There was a marked tendency for necrosis of the flap edges to occur and many bone-fragments were present in the sockets. These were associated with an intense inflammatory reaction. Even after 2 weeks epithelial union had not occurred and bone-dust was still being enfoliated or absorbed. Even particles lying between the flap and the alveolar bone were not well tolerated.

A central fibrous core persisted for over 3 weeks, and only after 4 weeks was the socket filled with new bone to the level of the alveolar crest. At 8 weeks a smooth ridge contour was established, but the removal of the external wall of the socket strongly influenced its final shape.

During a further series of experiments a marked reduction in the inflammatory response was observed following vigorous irrigation at the time of surgery to remove bone fragments. —SIMPSON, H. E. (1961), *J. oral Surg.*, **19**, 3.

G. R. SEWARD

Cherubism: A Report of Three Cases

The natural history, differential diagnosis, and management of the condition are briefly reviewed. Case 1 was a 6-year-old boy, neither of whose parents had evidence of this disease. The patient had firm, non-tender masses in both mandibular molar regions, the chin, and both tuberosities. Radiographs revealed cyst-like cavities in the affected areas which also reached back to the sigmoid notches on both sides. Some molar tooth germs were apparently absent and other unerupted teeth were displaced. No other lesions were found elsewhere either clinically or radiographically and clinical laboratory findings were normal. A two-stage operation was performed with

14 months between the stages. Mucoperiosteal flaps were reflected and the reddish-brown lesions curetted from the mandibular cavities. All the lower teeth were sacrificed, the cavities swabbed with zinc chloride and packed. An acceptable post-operative appearance was achieved. The histological examination of the excised material showed the typical giant-cell tissue of this condition.

Similar lesions involving the maxilla and mandibular molar regions and coronoid processes were found in Case 2, the brother of Case 1. Again, the rest of the skeleton was normal, as was the blood chemistry. Biopsies from the right mandible and maxilla confirmed the diagnosis.

Case 3 was the 53-year-old maternal grandfather of the two boys. Neither his parents nor his brothers or sisters appeared to have been affected. The swellings in his case were noticed at the age of 3 years, and were reduced surgically when he was 7 years old, with a good cosmetic result. Current radiographs reveal only traces of the condition.—ABBEY, F. S., and REECE, C. H. (1961), *J. oral Surg.*, **19**, 63.

G. R. SEWARD

Cavity Finish with High-speed Handpieces

A study was carried out to determine the possibility of using normal rotary cutting instruments in high-speed handpieces to produce smooth cavity margins. Diamond stones and cross-cut fissure burs run at proper instrument speeds made very rough ridged surfaces to the cavities. It was found that plane fissure burs produced the most satisfactory surface for finish—no horizontal markings—but there still remained a certain proportion of vertical grooves.

Further experiments showed that the more the rotational speeds were reduced the less the cutting efficiency, the smoother the finished surface. Therefore tests were carried out to discover if high-speed handpieces could be controlled in such a way as to run at reduced speeds for finishing purposes in order to obviate the necessity of changing to conventional instruments. This was achieved when cavities were finished at the stall-out zone. The stall-out zone is that condition in which the air-pressure to the air-turbine handpiece is reduced to the point at which a very small amount of operating force will stall it. This should not be confused with the condition when the air-turbine can be stalled by excessive load when operated at full speed and optimum air pressure.—CANTWELL, K. R., ALPIN, W. A., and MAHLER, D. B. (1960), *Dent. Prog.*, **1**, 42.

DONALD D. DERRICK

Periodontal Excision of the Palatal Root of Maxillary First Molars

Discomfort around the palatal root of the first molar was reported by two patients. Examination revealed recession and pockets approaching the apex of the palatal root of the molar, evidence of inflammation around the root, and purulent exudate. The only treatment possible, apart from extraction, was excision of the palatal roots. The latter course offered a good prognosis because tooth-mobility was within physiological limits owing to good bone anchorage of the buccal roots. Treatment consisted in adequate local anæsthesia, root-filling, excision of the roots near the crowns with a fissure bur, application of surgical packs to the areas for two weeks, and reduction of the lingual bulk of the crown to permit tissue massage. Gratification was expressed at the transformation from the original state of affairs to the now firm, pink, and stippled mucoperiosteum. The cases are illustrated with radiographs.—METRICK, L. (1960), *J. Canad. dent. Ass.*, **26**, 656.

G. E. B. MOORE

Subgingival Root Planing: A Comparison using Files, Hoes, and Curettes

Ninety teeth were planed subgingivally prior to extraction, 30 with hoes, 30 with files, and 30 with curettes.

It was found that the curettes produced the smoothest surfaces and the files the roughest. Curettes and hoes were more efficient than the files in removing calculus. The commonest sites for residual calculus were the mesial and distal surfaces.—BARNES, J. E., and SCHAFFER, E. M. (1960), *J. Periodont.*, **31**, 300.

B. WADE

EXTRA-ORAL TRACTION IN ORTHODONTICS

By S. GRANGER McCALLIN, L.D.S., D.Orth. R.C.S.

REFERENCE to the *Transactions* of our Society shows that Presidential Addresses have been delivered on a wide variety of topics, including the history of the Society, orthodontic politics, research, dental education, clinical theory, and occasionally clinical practice. I would suggest that all my predecessors, and certainly this is so in my case, have had one thing in common, a sense of responsibility to the Society and a desire to make a worthwhile contribution to the advancement of orthodontics on your behalf. What follows is my humble effort in this direction.

As a clinician I have chosen a clinical theme, and it came about as follows:—

About eighteen months ago, one became aware of the fact that more and more children in the Orthodontic Department at the Eastman Dental Hospital were wearing some form of extra-oral harness and that coincident with this, extra-oral procedures were receiving a fair amount of attention in the orthodontic journals. It occurred to me that the reason for this might bear investigation since it was not a technique that had ever acquired much popularity in this country.

With this evening in mind, this matter was given considerable thought, and what follows should be looked upon as an interim report on the indications for the use of the technique and an early assessment of its potentialities. I say "interim report" because it is too early for large numbers of completed cases to have been long enough out of retention for me to be able to show them. But I hope that the material I shall show may prove interesting and that it may stimulate further clinical study.

I have tackled the problem under three main headings:—

1. Why was extra-oral traction being more widely used?

2. Were there some specific types of cases in which it was indicated?

3. Was the technique simple enough, or could it be simplified so as to make it attractive to both the specialist clinician and the general practitioner orthodontist?

What was the rationale behind the increased use of extra-oral traction? I believe that there are two main reasons. First, it was hoped that directions of dento-alveolar growth might be controlled; and secondly, that in certain cases the extraction of premolars might be avoided.

Most clinicians believe that patterns of skeletal growth vary little after an individual's morphological characteristics become established early in life, and that orthodontic interference produces changes that are largely confined to the dento-alveolar structures. If this is so, is it not logical to attempt to guide the dento-alveolar rise from the bases, which brings the teeth together at a predetermined occlusal level, into the most favourable relationships possible within the morphological variations inherited by the individual?

So-called normal occlusion is the happy result of the interplay of a delicate state of balance between skeletal and soft-tissue harmony which results in upper and lower teeth coming together into an æsthetically and functionally acceptable interdigitation. It follows from this that if either of these basic characteristics varies from the normal so will a more or less severe malocclusion result.

I reminded you a moment ago that basic patterns of skeletal growth are probably not amenable to modification, but what of soft-tissue patterns? Orthodontists in this country since the war, in seeking to explain the aetiology of malocclusion, have been much preoccupied in understanding the effect of the soft tissues as they invest the developing dento-alveolar structures. Recently, our ideas about inherited variations of soft-tissue morphology and

Presidential Address given at the meeting held on Jan. 9, 1961.

behaviour have undergone a change. Whereas it was thought that these variations were usually of basic aetiological significance, and not amenable to change, we are now beginning to wonder if some of them may not be adaptive to their environment. If this is so, can we not expect some abnormal patterns of activity to re-adapt themselves to a new environment produced by orthodontic therapy? This approach to the soft-tissue problem may account for the apparently higher incidence of lip incompetence in young people. One doubts whether lip incompetence is less prevalent amongst adults; it is just that habitual postures are acquired that mask the basic abnormality. Fortunately for us, many acquired postures help to stabilize partially corrected occlusions. As time goes on, it would appear that skeletal variations are usually of more fundamental importance than soft-tissue abnormalities as aetiological factors.

If soft-tissue adaptation following occlusal correction is possible, as I believe it is, this could mean that it would be an advantage to correct certain types of malocclusion fairly early so that they could develop under more favourable conditions, with possibly some improvement in prognosis.

I have not included any cases that have been treated in the mixed dentition, because large numbers of them have been reported in the literature in recent years.

The reason American workers have employed this technique differs from the one I have suggested since they are not quite so preoccupied with the soft tissues as we are. Many of them, for ideological reasons, are trying to avoid extractions and are quite prepared to retain treated cases for very many years,

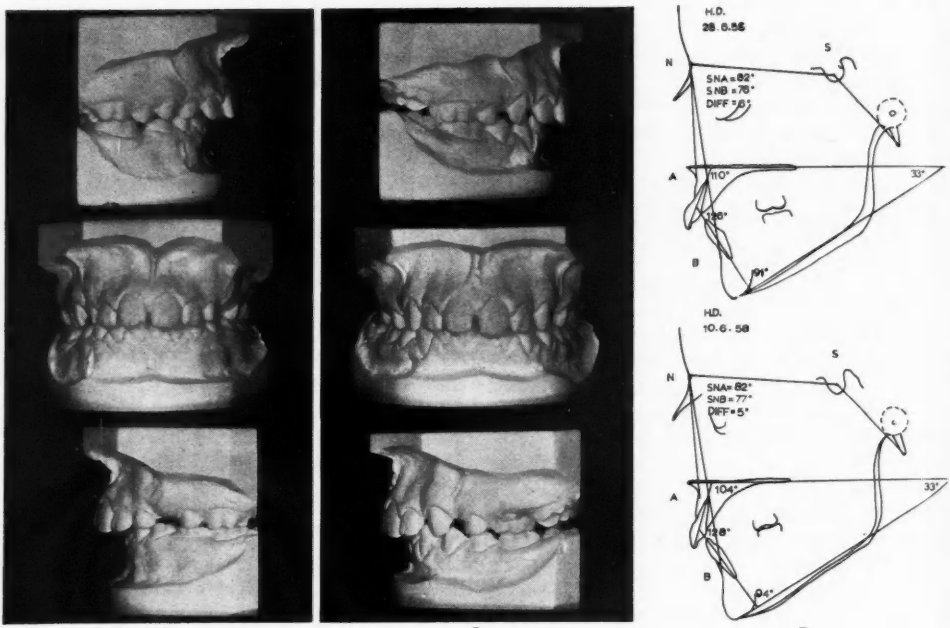


Fig. 1.—A, Models of a girl treated with extraction of both upper first premolars and lower right first premolar; B, Occlusion after twelve months' treatment and six months out of retention. *Note* spacing in maxillary arch from mesial $\underline{4}|$ round to mesial $|\underline{4}$; C, Lateral skull tracings of the original condition and two years later when patient had been out of retention for six months.

which makes it difficult for us to assess the stability of their results.

Let us consider for a moment what could happen when a restraining force is applied to the forward growth of the maxillary dental arch. We know that the maxilla and the mandible grow downwards and forwards away from the base of the skull, and that the forward component of growth is rather greater in the mandible than in the maxilla. We also believe that the relationship between downward and forward growth varies. In this way patients present with very different skeletal forms. Some have long narrow faces with high maxillary–mandibular plane angles, whereas others have short, deep, and wide faces, often with low maxillary–mandibular plane angles. Anteroposterior skeletal growth is relatively less in the former than in the latter. I believe that we shall find that a restraining force applied to inhibit forward growth of the maxillary arch will induce a greater response in those cases where forward growth is relatively greater than downward growth. This requires investigation.

Our difficulty, of course, is that so often we are confronted with cases where neither downward nor forward growth predominates. Crowding in many of these is minimal, but unfortunately mainly confined to the canines and incisors in one or both of the arches. In Class II, division 1 cases there is frequently mild imbrication of the lower incisors with no crowding in the upper arch owing to proclination of the upper labial teeth. In Class II, division 2 cases æsthetics are frequently impaired as the result of quite a small space deficiency with upper laterals overlapping the instanding upper centrals. Again, in Class III cases partially excluded upper canines may be the only occlusal abnormality, but they can be most disfiguring.

Handling this type of problem is the second reason why clinicians have become increasingly interested in extra-oral traction. So often the space needed for reduction of anterior crowding is less than the equivalent of one premolar on either side, and far too many cases are mutilated by extractions which result in poor function owing to tipping of buccal teeth, leaving slack and sometimes open contact points and frequently unsightly residual extraction spaces.

Here is such a case:—

This was a girl (*Fig.* 1) aged 9 years and 4 months in June, 1956. She had a Class II dental base relationship with a maxillary–mandibular plane angle of 33°. There was an overjet and a complete overbite associated with mild lip incompetence. The early loss of the lower right second deciduous molar had been followed by a mesial shift of the lower right first molar and the lower incisors had drifted to the right. The third molars were present.

The treatment prescribed was extraction of both the upper and the lower right first premolars, to be followed by retraction of both upper canines and later the upper labial teeth.

The teeth were extracted in December, 1956, and treatment continued until December, 1957. Records were obtained in June, 1958, when the occlusion had been out of retention for six months.

The models (*Fig.* 1 B) show that it had not been possible to close the upper extraction space or to reduce the overjet very much, and that spacing mesial to the upper canines was now present.

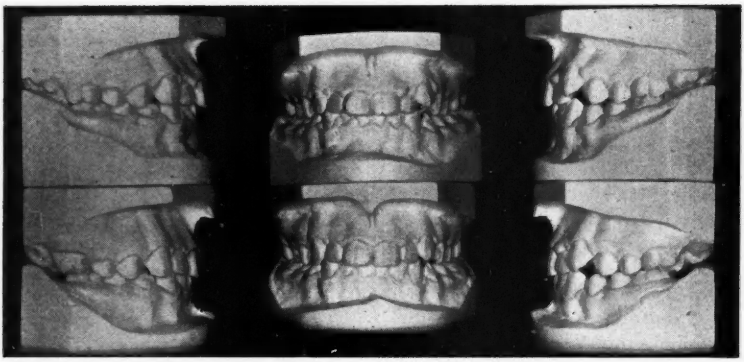
The difference between the SNA, SNB angles (*Fig.* 1 C) had reduced one degree.

The patient was last seen over two years later in August, 1960, when a clinical note was made to the effect that the upper right premolar extraction space had closed slightly, but the rest of the spaces had remained unchanged. This is quite three years out of retention, and the patient had grown considerably. I would suggest that there was an alternative method of treating this case. If the upper buccal teeth had been retracted, probably with extraction of the upper second molars, much better contact between the upper buccal teeth could have been expected and the overjet could have been reduced at least as much.

I drew attention to the small change in the SNA, SNB angle difference, not because it does not change with extraction of upper first premolars, and reduction of overjets, but because it will be shown that it can change also

with retraction of buccal segments without premolar extractions. Nobody now considers that points A and B are on basal bone; they are, nevertheless, convenient points, which are not too difficult to identify on lateral X-ray plates, that can be used to confirm the reorientation in a vertical plane of the anterior dento-alveolar structures.

I propose to refer to changes in the SNA, SNB angle in the cases that follow just to underline the fact that we are justified in believing that extra-oral traction is an effective restraining force to the forward growth of the maxillary teeth. It does not seem to me to matter whether the maxillary teeth are moved backwards or are prevented from moving forwards whilst the mandibular dentition continues to move forwards, so long as one or the other takes place to bring about a re-orientation of the labial and buccal teeth.



A

B

Fig. 2.—A, *Upper models*: A Class I case with mild antero-posterior crowding. *Lower models*: After extra-oral traction to a removable appliance had been worn for three months. Four second molars had been extracted; B, Occlusal view.

As I have already said, it is only recently that this technique has been used at all extensively at the Eastman Dental Hospital, and we have relatively few completed cases. Even if we had we would still be faced with the well-recognized problems of making and superimposing tracings from lateral skull head plates. Nevertheless I have one or two cases to show you to give you some idea of the type of changes that can result from the use of this technique.

In *Fig.* 2 A the patient had a Class I malocclusion on Class I dental bases. The lower incisors were inclined lingually in association with lip incompetence. All four buccal segments were forward, and both upper and lower centre lines were slightly to the left. There was partial buccal exclusion of the upper left canine, imbrication of the lower incisors, with impaction of the lower left first premolar. The crowding on the right was minimal and confined to the canines and laterals in both arches. The buccal occlusion was Class I on the right and very slightly Class II on the left. There was a small overjet and a slight increase in the overbite; four large third molars were developing. The caries incidence was low.

Treatment consisted of extraction of all four second molars followed by extra-oral traction to the upper buccal teeth. A removable upper appliance was fitted on Sept. 1, 1960, and reference models were taken again on Dec. 5, 1960, just over three months later.

You will observe a marked improvement in the position of the upper left canine, the partial disimpaction of the lower left first premolar, and a quite considerable reduction in lower incisor crowding (*Fig.* 2 B).

Without treatment following the extraction of the second molars, there might have been a gradual improvement, and this case is shown only to illustrate the speed of response.

I suggest that with extraction of upper first premolars only, it would have been difficult to eliminate the extraction spaces; the upper incisors might have moved apart and lower incisor crowding would almost certainly have increased. It should be mentioned in passing that should lower third molars erupt impacted, distal to lower first molars, following extraction of lower second molars, disimpaction of these teeth by tilting them distally presents no problem.

Fig. 3 shows models of a very similar case, except that this girl, who was 13 years old when first seen, had no third molars. Extra-oral traction was applied to the upper buccal teeth for nine months. The second series of models shows the condition two years out of retention. General skeletal growth was excellent.

Fig. 4 shows the records of a boy aged 15 years exactly in July, 1956. He was diagnosed as having a Class II, division 2 malocclusion on a Class II dental base relationship. The SNA angle was 87° and the SNB angle was 82·5°, a difference of 4·5°. There was crowding of upper incisors with the upper buccal teeth mesially inclined and in contact with the labial segment. There was lower incisor imbrication. The overbite was above average and complete. The molar relationship was Class II on the right and pseudo-Class II on the left. Four unerupted third molars were present.

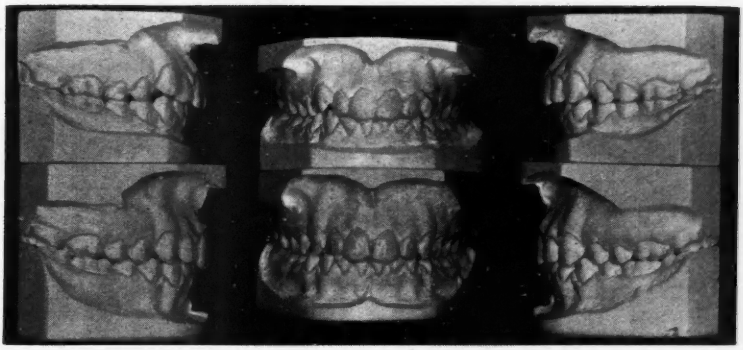


Fig. 3.—*Upper models*: Occlusion of a Class I case where the upper buccal segments were forward relative to the upper labial teeth. The patient had no third molars. *Lower models*: Condition two years out of retention. The upper buccal teeth were moved distally with extra-oral traction to a removable appliance.

The treatment planned was to attempt retraction of the upper buccal teeth with extraction of upper second molars if necessary. Extraction of upper first premolars was contra-indicated since the upper buccal teeth were mesially inclined and space closure might be difficult.

Upper molar bands with a stopped labial extra-oral traction bow were cemented in July, 1956. When upper first molars had been taken back with distal tipping, spacing of the buccal teeth mesial to the molars was closed up with a succession of removable appliances.

A retainer was fitted in November, 1957, sixteen months after commencement of treatment, to hold improved alinement of upper incisors. Retention was discontinued two years later in November, 1959.

Changes produced are shown (*Fig.* 4 B) on records obtained in August, 1960, the case being nine months out of retention. The relationship of the buccal segments had improved, and there had been a small reduction in the overbite with improved alinement of the upper incisors. The lower incisors were less imbricated than when the boy was first seen. This was rather remarkable and it could mean that the distal movement of the upper buccal teeth had acted as a mild restraint to the forward movement of the lower buccal teeth, as the lower incisor apices had been carried forward with the mandibular growth. It may yet be decided to extract the third molars.

Fig. 4 C shows some of the changes in the angles on the tracings of the lateral skull X-rays. It will be noted that there has been a reduction in the SNA, SNB angle difference of 1·5°, apparently as a result of the relative forward growth of the mandible.

The next case (*Fig.* 5 A) is of a girl aged 11½ years in March, 1959.

She had a Class II, division 1 malocclusion, with a small overjet and an incomplete and reduced incisor overbite associated with a history of early thumb-sucking and the presence of a mild anterior interdental sigmatism. The dental base relationship was Class II. There was a forward shift of the right upper buccal teeth following loss of the upper right deciduous canine, which had been extracted early to permit the instanding upper right lateral to move labially into better alinement. The upper right first molars had rotated mesiopalatally. The space available for the eruption of the left upper canine was adequate, but would not be so if the overjet was to be reduced. The space for erupting the lower left

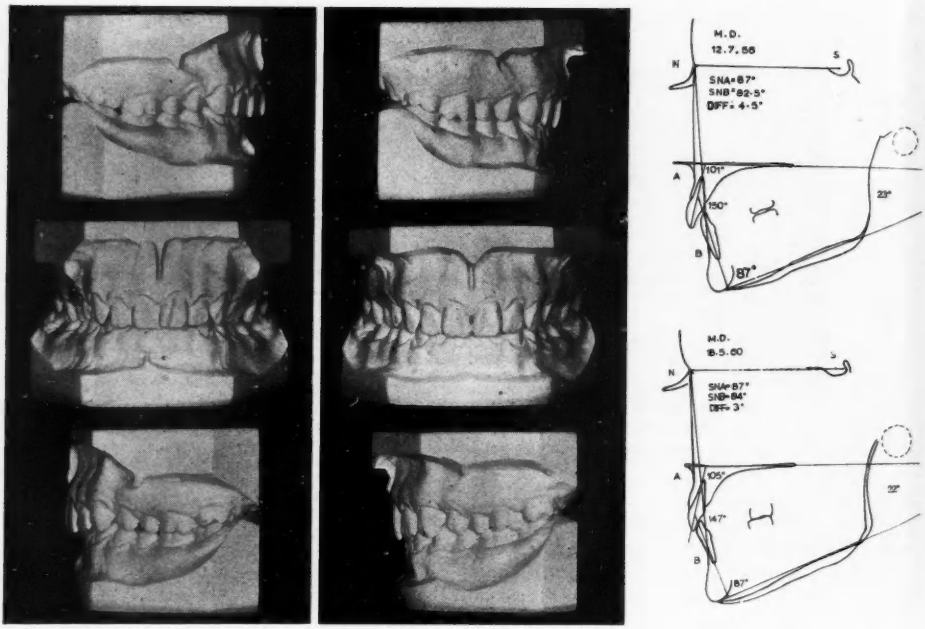


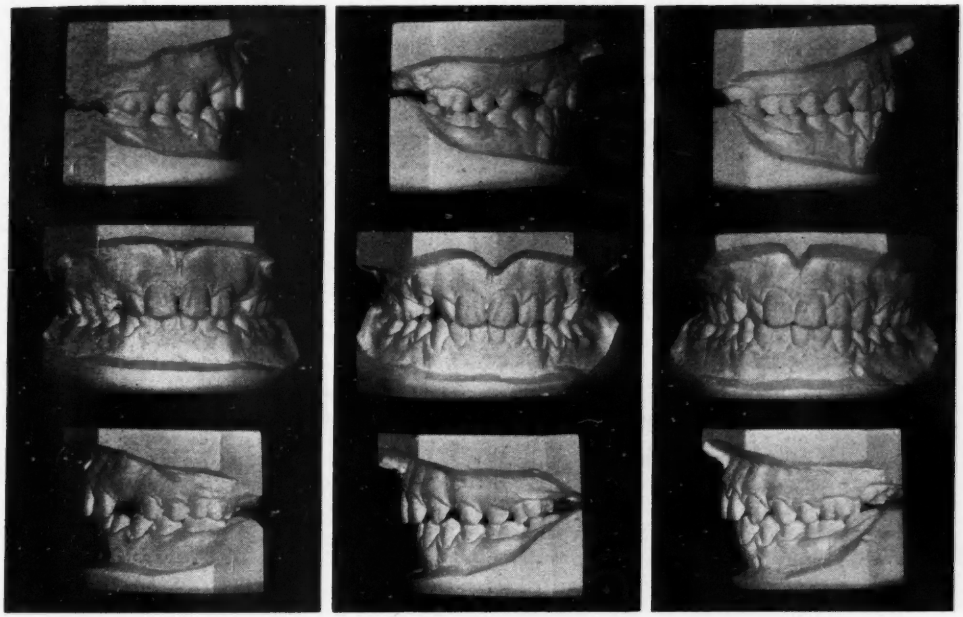
Fig. 4.—A, Models of a boy with a Class II, division 2 malocclusion. The mandible was post-normal; B, Occlusion four years later, nine months out of retention. The upper buccal teeth were moved distally with extra-oral traction. No teeth were extracted. C, Lateral X-ray tracings.

canine was inadequate and the lower centre line was just to the left of the upper centre line. This indicated that the lower buccal teeth were developmentally forward relative to the stable position of the lower incisors in the muscle action existing at that time. This muscle action might have been adaptive in character in association with the mild skeletal abnormality and the early thumb-sucking, but was suspect on account of the interdental sigmatism. Caries incidence was low.

Treatment: In view of the tongue activity, prognosis for a reduction of the overjet was possibly rather poor. Therefore, extraction of four premolars to reduce crowding might create space in excess of requirements which could never be eliminated without gross mesial tipping of molars and premolars and an unstable over-retraction of incisors.

In view of this, it was decided to move the upper buccal teeth distally with extraction of second molars from both arches. The fact that the second molars were never extracted, owing to a misunderstanding, has resulted in some interesting occlusal changes.

A stopped labial arch against bands on upper first molars was fitted in March, 1959, with extra-oral attachments, and this was worn, followed by a removable upper appliance to take the upper right premolars distally, until December, 1959, when appliances were abandoned since more than enough space was available for the upper canines.



A B C

Fig. 5.—A, Models of a girl with Class II, division 1 malocclusion. The mandible was post-normal. B, Models after nine months' treatment with extra-oral traction. C, Models nine months after treatment had been discontinued.

The models in *Fig.* 5 B illustrate the condition at that time. You will observe that the buccal teeth had been over-retracted, that the upper right lateral had drifted lingual to the lower teeth, and that the overjet had been partially reduced. The upper right second molar was just beginning to erupt. The upper and lower centre lines were now coincident, the lower left canine having completed eruption.

The patient was seen in May, 1960, when little change was observed, and again in

October, nine months out of retention, when some detailed changes were recorded (*Fig.* 5 C).

You will appreciate that space for the upper right canine and lateral was not quite adequate and the lateral had remained palatally placed just lingual to the lower lateral. The lower incisors were imbricating with the right lateral moving labially, and the lower centre was moving across to the right of the upper centre. The overjet was less than it had been originally, into the floor of the mouth and caused proclination of the lower incisors.

Although this case is not finished I expect a satisfactory outcome which I do not consider we could have achieved with extraction of upper premolars, because of the probability of spacing of the upper incisors, mesial tipping of the upper buccal teeth, difficulty with elimination of extraction spaces, and increased crowding in the lower arch.

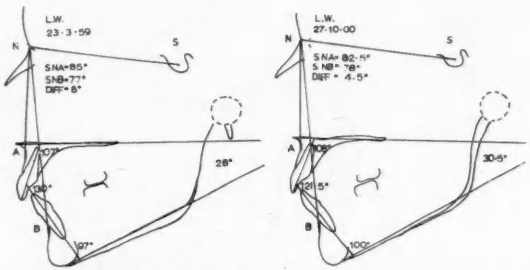


Fig. 6.—Tracings from lateral X-rays of case shown in *Fig.* 5. These show dento-alveolar re-orientation following extra-oral traction to maxillary arch.

and the overbite had also been fractionally reduced. All four second molars had erupted. Owing to faulty appliance manipulation, the upper right first molar had moved palatally into cross-bite with the lower right first molar.

The patient has now been referred for extraction of all second molars, but treatment to date illustrates several interesting points.

Again (*Fig.* 6), the SNA, SNB angle was reduced, this time by 3·5°, largely as the result of a relative distal movement of the maxillary dentition, but in this case there had been much less forward movement of the mandibular dentition as a whole, whereas the lower incisors appear to have proclined. The overbite and overjet have been reduced slightly, with the proclination of the lower incisors. If the upper incisors have moved back they must have done so bodily. I suggest that while the upper buccal teeth were free to respond by moving distally, the incisors were controlled by the unfavourable tongue activity. As the upper incisors were held by the removable appliances used to retract the upper right premolars, the tongue was forced

In the last case (*Fig.* 7 A) there are some features not unlike the previous one. These are records of a girl aged 12¼ years in March, 1958.

Her dental base relationship was Class II. The occlusion was Class II, division 1. The lips were incompetent, and to obtain an anterior oral seal the tongue was thrust forward to contact the contracted lips. The upper buccal teeth had drifted forward to maintain contact with the proclined upper labial segment. The overbite was incomplete, associated with the tongue action which was thought to be adaptive in type. The upper left central and lateral were rotated. There was no speech abnormality. All third molars were developing.

Treatment prescribed was distal movement of the upper buccal teeth with extraction of the upper second molars to correct the buccal occlusion and to provide space into which to reduce the overjet with reduction of incisor rotations. The extraction of premolars was contra-indicated in case a stable reduction of the overjet proved to be impossible in association with the muscle activity.

Treatment was started in April, 1958, using very light Class II intermaxillary traction from a removable lower traction appliance, which carried spurs to prevent the over-eruption of the lower second molars, to a Johnson twin-wire apparatus in the upper arch. There were compression coils on the end tubes of the upper appliance activated to move the upper first molars distally. Extra-oral pressure was applied to the anterior ends of the end tubes by hooking the extra-oral traction on to the inter-maxillary traction hooks on the twin arch. The inter-maxillary traction was worn for 10 hours out of 24 and the extra-oral only for the remaining 14 hours.

After twelve months, in April, 1959 (*Fig.* 7 B), the buccal occlusion had been corrected and the overjet and the rotations of the upper incisors had been reduced, as their crowns had been tipped back with forward movement of their apices. Lateral tracings (*Fig.* 8) suggest that there had been some forward movement of the lower arch, while in the upper the lack of change in the SNA angle is probably due to the forward movement of the upper incisor apices. The difference between the SNA, SNB angle was now 4° instead of the original 5·5°.

At this time, the lower appliance was discarded and a removable upper retainer was fitted which was not stabilized with extra-oral traction. This was worn for ten months and then discarded.

The most recent records (*Fig.* 7 C) were obtained in October, 1960, eight months out of retention. It will be noticed that there has been a partial return of the overjet, but little deterioration in the buccal occlusion. There is slight spacing in the upper labial segment and distal to the upper left canine. The overbite is still incomplete.

The muscle patterns (*Fig.* 9) were unchanged except that the degree of lip incompetence appeared to be slightly less severe and there was a tendency for the lower lip to function in front of the upper incisors in maintaining an anterior oral seal.

With further development, one would anticipate that the soft-tissue patterns will become more favourable, and with no pressure behind from the upper buccal segments it would be surprising if the overjet were not reduced to some extent. It might have been better if the retainer had been stabilized with extra-oral traction. The case is being kept under observation.

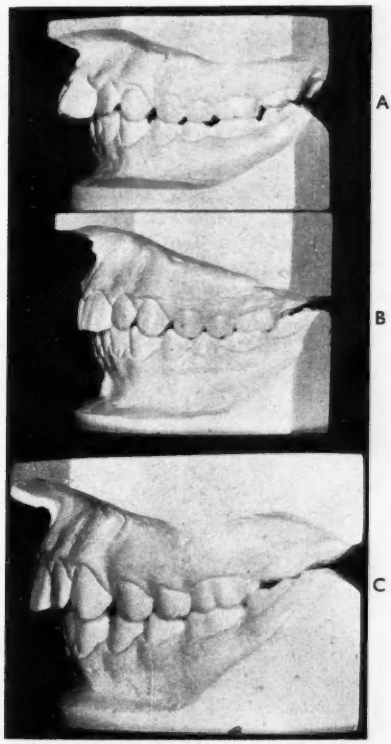


Fig. 7.—Models of a girl with a Class II, division 1 malocclusion. The mandible was post-normal. A, Before treatment; B, After treatment; C, Eight months out of retention.

Very light Class II inter-maxillary traction had been used to supplement extra-oral traction to the maxillary arch. $\frac{7|7}{}$ had been extracted.

I hope that you will agree that these cases have served to illustrate that extra-oral traction alone, or in association with other types of therapy, has benefited these patients. The fact that none of the cases is truly finished does not seem to me to matter. Re-orientation of opposing teeth and arches has been effected and tooth movements of this

type must be of value in many cases, with widely differing morphological features.

This brings me to my second main heading, namely, What are the indications for the use of extra-oral traction either alone or as a supplementary force?

I suggest, as I mentioned earlier, that this type of therapy should be considered in mild examples of Class I, II, and III malocclusions. This is particularly so when there has been very little or no mutilation of the arches due to the premature extraction of deciduous teeth. In other words, where the extraction of premolars will create space in excess of requirements that could only be managed with complex techniques.

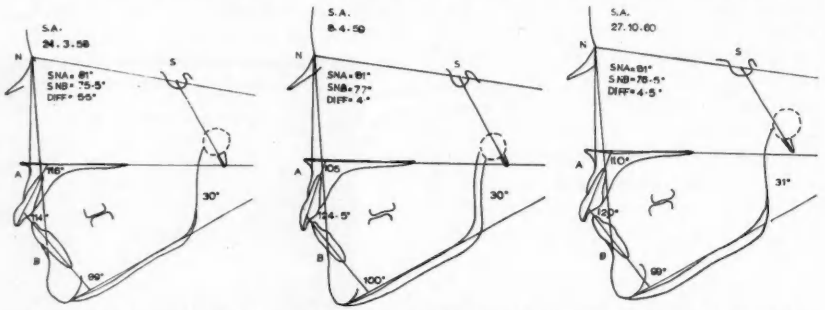


Fig. 8.—Tracings of lateral X-rays of case shown in *Fig.* 7. Tracings on right show occlusion eight months out of retention.

Fig. 9.—Photographs of patient shown in *Figs.* 7 and 8.

One important contra-indication to the use of this technique is in cases with considerable lower incisor crowding which is almost invariably associated with the lower buccal teeth being forward on the base. When this is the case, correction of the buccal occlusion by distal movement of the upper buccal teeth will not result in their being taken far enough back to permit a reduction of a mild overjet or upper incisor crowding. Occasionally, where caries incidence is low and the status of the first molars is satisfactory, this difficulty can be overcome with extraction of lower second molars. Obviously the presence of third molars must be confirmed and they should not be lying at grossly unfavourable angles. It is well known that lower incisor crowding can be reduced with extraction of second molars, often with no appliances, but I would caution against wholesale extraction of second molars from the lower where there is the slightest doubt about prognosis for the first molars.

Always keeping in mind this point about the position of the lower buccal teeth on the base and relative to the lower incisors, we can pass on to some specific types of cases in each occlusal group where extra-oral traction to the upper arch is indicated.

Class I.—All cases where the lower arch alinement is good and the malocclusion is confined to mild crowding of the upper incisors, or partial exclusion of mesially inclined upper canines without incisor crowding. If upper first molars are distally inclined, the technique is contra-indicated since this is an indication of a degree of anteroposterior base deficiency. If, however, the first molars are mesially inclined, extra-oral traction should be considered. I am taking it as read that third molars must be present and favourable, both as to size and position. There are large numbers of Class I cases of this type especially associated with mild Class II skeletal patterns.

Class II, Division 1.—All cases where the lower arch alinement is good and the overjet is mild, especially those where the upper buccal teeth are mesially inclined and a reduction of the overjet will position the upper incisors inside lower lip activity.

The technique, working in association with other apparatus—for example, part-time Class II inter-maxillary traction—is especially valuable where tongue activity against a lower lip is holding upper incisors proclined and the lower incisors down to maintain an incomplete overbite. One is frequently afraid in this type of case that closure of premolar extraction spaces may be difficult, if not impossible. The technique has not proved effective in these cases working alone, since a continuous 24-hour pressure is necessary to reduce an overjet maintained by tongue thrusting. If such a tongue thrust is associated with a speech defect, prognosis is always bad unless the speech abnormality is of a type that will improve with age, when this technique will probably be as effective as any other.

The early treatment of quite severe Class II, division 1 cases in the mixed dentition stage is worth considering. Many cases treated at this stage of development have been reported in American journals, and when mild soft-tissue abnormalities are associated with these, it may be an advantage to correct the occlusion early. We have a number of cases of this type under treatment at the Eastman Dental Hospital at this time, but it will be a few years before we can assess for ourselves the true value of this type of interference at this age.

Class II, Division 2.—These cases fall into two main groups: those with lower arch crowding and those without. The former are always difficult to treat with any technique, and prognosis is usually poor, but many of the latter respond readily to extra-oral traction. Again, those with distally inclined upper first molars should be treated with the extraction of premolars, but many of these cases have buccal teeth mesially inclined and these can usually be taken distally.

Class III.—In so many of these cases, one is loath to extract upper first premolars because the loss of these teeth removes buccal support from the upper labial segment, rendering the incisors vulnerable to palatal collapse if residual space cannot be completely eliminated. There are large numbers of Class III cases where a patient is able to eliminate a reverse overjet by retracting the mandible to bring the occlusal tips of the upper and lower incisors into contact. If the crowding in the maxilla is not too severe and the lower buccal teeth are forward in contact with the labial teeth, these cases will respond well to the extraction of upper second molars and lower first premolars, followed by slight proclination of the upper incisors and extra-oral traction for distal movement of the buccal teeth. Frequently, no appliances are necessary in the lower.

There are other uses for the technique that are worth considering:—

1. It can often be used effectively for the retraction of maxillary teeth in patients who adopt a habitual forward posture to obtain an anterior oral seal because of the presence of a mild overjet. Class II inter-maxillary traction is sometimes unavailing in correcting this type of Class II, division 1 case, since the patient postures forward as soon as the inter-maxillary elastics are hooked up, and reciprocal pressure is therefore reduced.

2. As an anchorage reinforcement in association with inter- or intra-maxillary traction mechanics, extra-oral traction can frequently just tip the scales towards a

favourable outcome in a case that would otherwise fail. Some of my colleagues are unkind enough to call this my "belt and braces" approach to treatment, but I am quite unrepentant, having found it most valuable in association with many types of appliances.

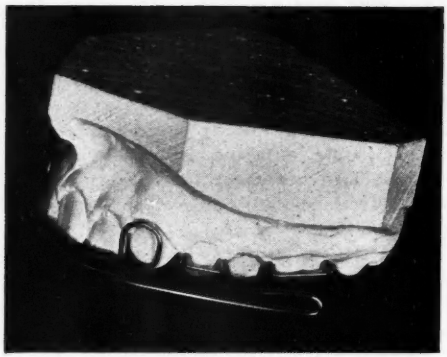


Fig. 10.—Extra-oral "whiskers", 1·25-mm. wire, attached to a labial 0·9-mm. wire which stands away from the incisors.

3. Retention of certain types of cases does sometimes present a problem when an overjet is associated with tongue thrusting activities, which tend to move retracted upper incisors forward. These can often be retained with extra-oral traction applied to the upper retainer, which will resist forward pressure of a tongue thrust of this type so that a reduced overjet is held while tongue action is given a chance to become modified. Obviously the effects of an endogenous tongue thrust cannot be controlled in this way; but where the muscle activity is adaptive in type, this procedure is sometimes helpful.

This brings me finally to a few words about the technique itself. You will remember that I said earlier that one of the great advantages of extra-oral traction was that the procedures were simple and well within the capabilities of general practitioners who do not have the time to acquire a high degree of appliance expertise.

The secret of success lies in the design of the appliance and its extra-oral components which must be easy for the patient to manage and tolerate. Generally speaking, if a clinician can show that he is confident that the apparatus he is fitting will work, some of this confidence will be transferred to the patient, and, so long as the apparatus is not uncomfortable, co-operation can be expected. I suggest that one of the main reasons why this technique has not been popular in the past is because the headcap or cervical harness has been tedious to make, uncomfortable to wear, and liable to become unhooked. This has led to a high incidence of non-co-operation and a lack of enthusiasm on the part of the clinician.

For the past two years I have been using a removable appliance (*Fig.* 10) with extra-oral "whiskers" of 1·5-mm. wire attached to a 0·9-mm. labial bow which stands away from the upper incisors. Incorporated in the appliance (*Fig.* 11) is a 1·25-mm. expansion Coffin spring, and where necessary a flat anterior bite-plane. The appliance is activated by pinching the reverse bends on the bow, which stands the bow away from the incisors and opens the anterior part of the palatal plastic. The heels of the appliance are then just pulled wider apart so that the division between the two halves remains parallel. This will expand the buccal teeth just enough to permit them to move distally and remain correctly related bucco-lingually to the lower teeth. I have found that this method of attaching the extra-oral "whiskers" on to the labial bow instead of inserting it into tubes on the buccal clasps is more rigid and overcomes the tendency for the clasps to become distorted with loss of appliance anchorage.

The cervical strap is exceedingly simple, being made of 1-in. wide terylene petersham which is folded back on itself and sewn round the edges, except right in the middle, so that the anterior end of the traction hook can be forced through the anterior end of the strap. The posterior end of a No. 8 elastic is knotted through itself at the apex of the triangular piece of 1·25-mm. wire, which has been forced through the strap near the edge and passed over the open end of the diamond anteriorly. The triangle, which is half an inch from the centre at the back, is an improvement on a

hook sewn in the middle because it holds the strap flat and prevents it from rolling up into a string, which is uncomfortable.

The diamond prevents twisting and rolling of the traction hook. The "whisker" hooks are bent in the vertical plane and the traction hooks in the horizontal plane. One rubber

The "whiskers" are then adapted to the face and turned back in a vertical plane in front of the mark.

A prefabricated strap is selected which will end a little short of the mark on both sides when passed round the neck and pulled firmly forward. The traction hooks which have

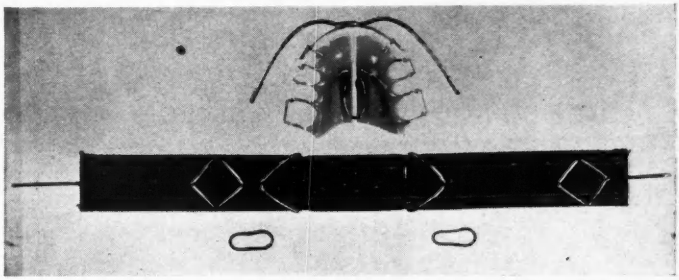


Fig. 11.—Palatal view of appliance shown in *Fig.* 10 with cervical harness. Palatal Coffin spring 1·25-mm. wire. All wire attached to harness is of 1·25-mm. gauge. The strap is made of 1-in. wide terylene petersham.

A B C D

Fig. 12.—Shows sequence of operations for fitting the appliance. A, Face marked for selection of strap of suitable length; B, Suitable strap selected; C, "Whisker" marked just in front of mark on face; D, "Whisker" turned back on itself to form a hook in the vertical plane. The hook coming forward through the strap flap is bent back on itself in the horizontal plane.

each side is adequate and should probably not be exceeded.

The sequence of events for fitting the appliance is as follows:—

The clasps are adjusted for anchorage, the appliance is expanded very slightly, and the labial bow, which is stood away from the incisors, is adjusted to the correct level for the lip line.

The patient's face is then marked just behind an imaginary line dropped vertically from slightly behind the outer canthus of the eye on both sides (*Fig.* 12).

been prefabricated so that they project about 1 in. in front of the strap are then hooked over the "whiskers" with the rubbers attached.

The traction hooks are bent slightly at the appropriate point to allow them to pass round the posterior border of the mandible.

Lastly, the "whiskers" are adapted to lie close to the face, but not too close to the corners of the mouth so that saliva will become trapped, which can lead to soreness.

You will note that the "whiskers" come out of the mouth at the closed lip line to prevent

the upper or lower lip displacing them as the lips are approximated.

An assistant or a technician can make up a supply of straps which I keep in lengths of 8½ in. increasing by half-inches up to 11½ in.

Fig. 13.—Extra-oral gear used in association with the twin wire arch technique. Labial bow inserted into the lower of two tubes attached to buccal of first molar bands.

These will cover nine-tenths of the cases. Just to be sure that I shall have one available I select the correct strap when I take the impression for the appliance.

Instructions to the patient are: "If you cannot manage to sleep with it the first night don't worry, but keep trying until you can." The appliance should be worn for 10 or if possible 12 hours in 24.

One would expect to see a response in four weeks, and then the patient can be seen at 6 weekly intervals.

This same harness can be fitted on to "whiskers" attached to a stopped 1-mm. labial bow in buccal tubes on upper first molar bands. This is useful in the mixed dentition.

It is also possible to use the technique in association with other types of fixed appliances (*Fig.* 13) by inserting the labial bow in the lower tube of a double-tube attachment on the buccal of upper first molar bands. With extraction of upper second molars, it is often possible to retract the buccal teeth as incisor crowding and rotations are reduced.

Finally, if the "whiskers" are lined up below the level of the labial arch, the first molars will be tipped back—if above the level of the arch the first molar apices will be moved back. When used with a removable appliance one usually lines them up just above the level of the clasps. If you are dealing with a mutilated post-normality and only want one side to go back, the "whisker" on the affected side should be longer than on the side where you do not require distal movement. It is remarkable how effective this is. There is no need to attach "whiskers" anywhere but in the middle of the labial bow.

My treatment of this subject has of necessity been brief, and, I am well aware, somewhat superficial, but I hope it will have stimulated an interest in the potentialities of this technique.

My grateful thanks are due to members of the Orthodontic Department at the Eastman Dental Hospital for allowing me to show their cases, to our clinical secretaries for typing the script, to Mrs. F. Hale for reproducing the tracings of the lateral skull X-rays, and to the Photographic Department for the preparation of the illustrations.

Mr. K. E. Pringle, in moving a vote of thanks to the President, said that he was sure that Mr. McCallin would bring to his office the elegance and good sense for which he was so well known to them all. To be the President of the British Society for the Study of Orthodontics was, for an Englishman, an acknowledgement of the high respect in which he was held by his colleagues. He knew that in the coming year their President wished the practice of orthodontics to be well to the fore. Their programme indicated that this would be so. The President's Address, to which they had all listened with very great interest—it was for many of them a new approach—also showed the practical turn.

He wished to assure the President that they all hoped he would have a very happy year of office.